THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXIX. No. 1781.] LONDON, JUNE 29, 1897. [49TH YEAR. PRICE 6d.

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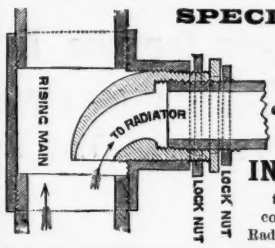

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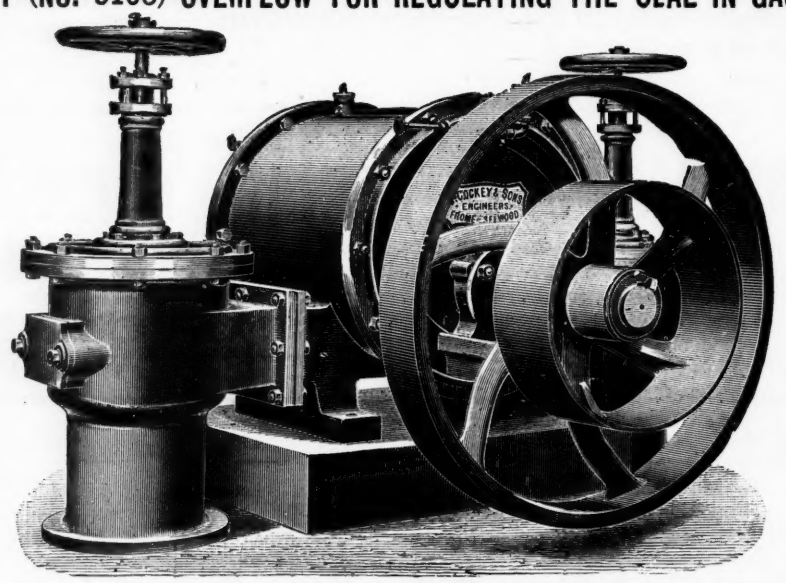

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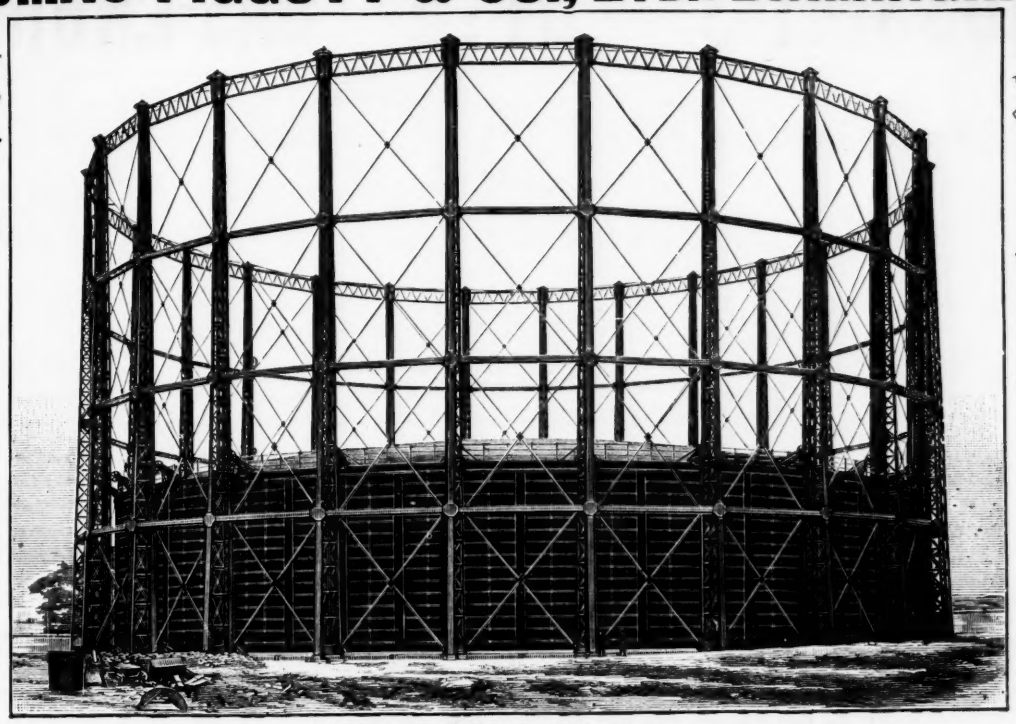

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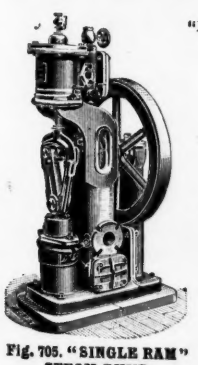

Fig. 705. "SINGLE RAM" STEAM-PUMP.

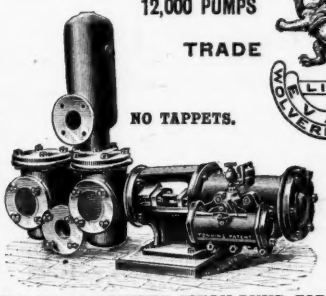

Fig. 598. "CORNISH" STEAM-PUMP FOR BOILER FEEDING, &c.

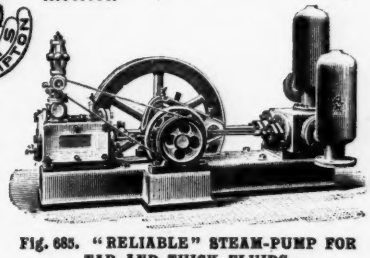

Fig. 685. "RELIABLE" STEAM-PUMP FOR TAR AND THICK FLUIDS.

Fig. 712. "DOUBLE-RAM" STEAM-PUMP.

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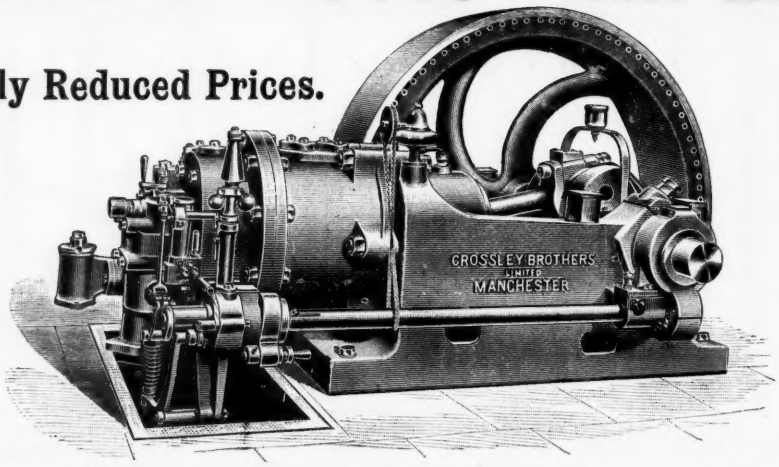

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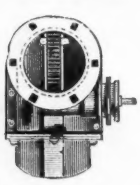

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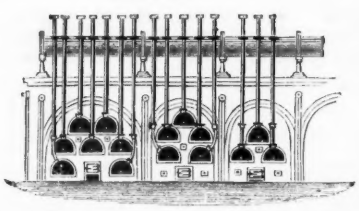

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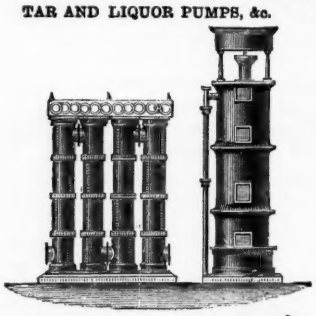

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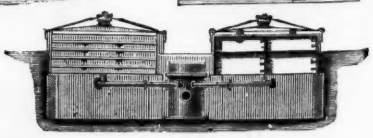

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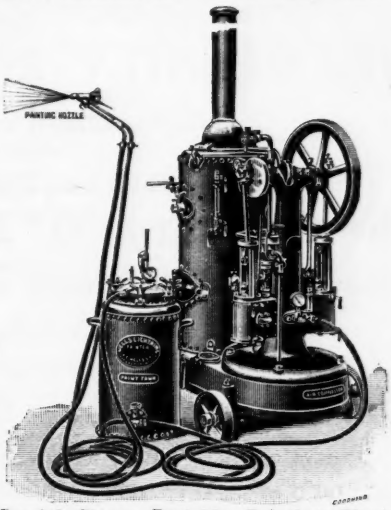

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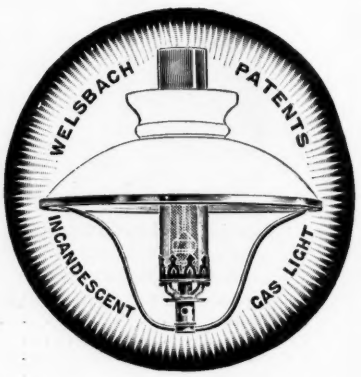

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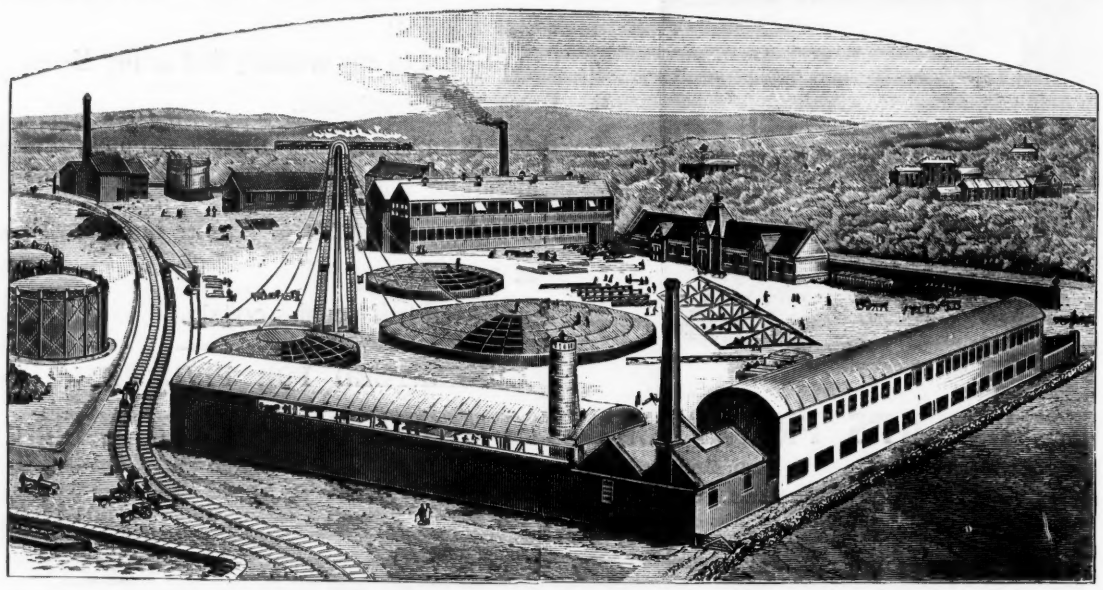

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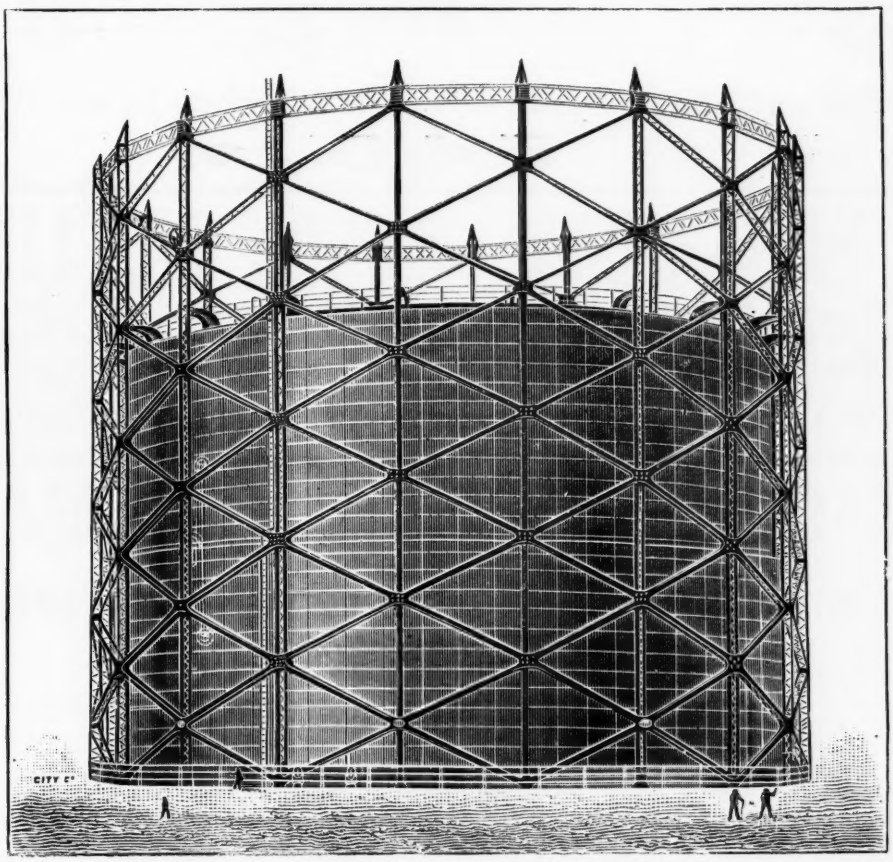

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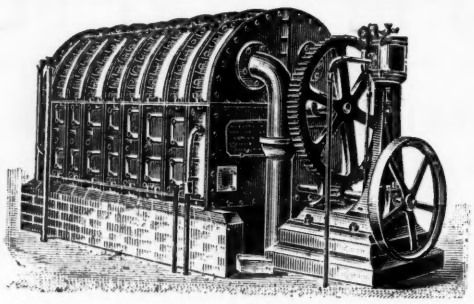

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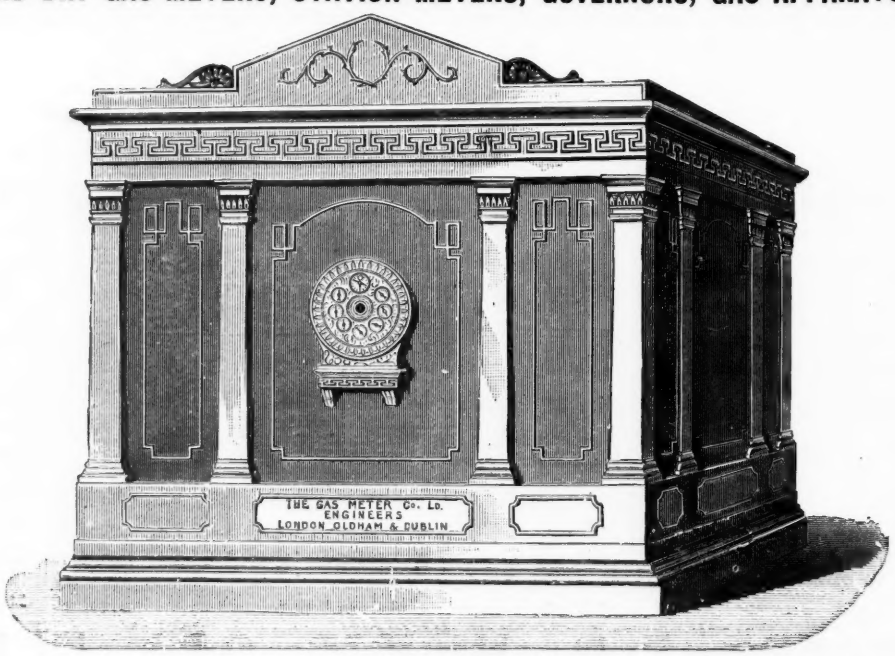

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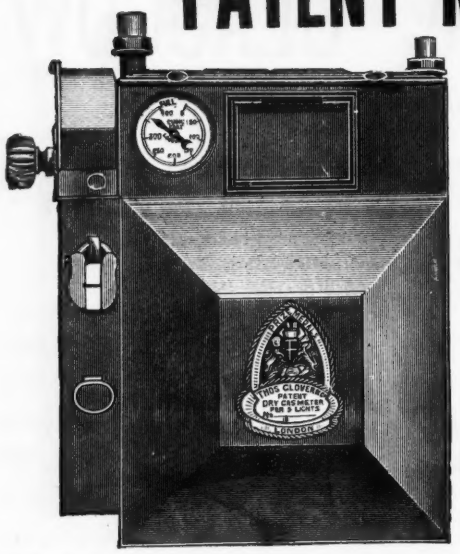

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[See also Advt. p. 1528.

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TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

EDITORIAL NOTES.

Honour to Whom Honour is Due.

THE greatest day of the century has come and gone; the most notable week of a most wonderful year has passed into the domain of history; and all is well. There is little else to be talked about just now but the Diamond Jubilee celebrations, by which the people of the greatest empire the world has ever known have recognized and commemorated this consummation of the longest and noblest reign enjoyed, or endured, by any wearer of a crown since the world began. And now it has all been gone through—the processions, the gatherings of all sorts and conditions of mankind, the banquets, the reviews, the pageants, the illuminations—and we, the people of England, can breathe again. Surely, our first impulse at such a time must be to render thanks as a nation that everything has gone right—that from the august Head of the Realm herself down to the most helpless unit of the vast multitudes that have assembled to do her honour, none has received scathe or scar as the price of all this glory. *Non nobis, Domine!* But forasmuch as the ways of the Disposer of Events are manifested through human agency, let us take this opportunity for commending the foresight, the wisdom, and the devotion to duty of those in responsible positions who managed these public functions so successfully. Next let us praise the multitudinous British workman for the excellence of his handiwork—the carpenters who made the stands that did not collapse; the gas-fitters and electricians who set the illuminations so that there was no serious explosion or burning; the decorators whose beautiful work stood the strain of wind, weather, and wear; the coachmen and the grooms; the carters and vanmen; the public caterers; the turncocks and the lamplighters—how particularize when every man in his degree did his duty? And what of the British public itself, from the aristocrat at his club window to the poor man in the gutter outside—was there ever such a mass of orderly, law-abiding, mutually helpful people seen on this earth before? It is not for us to speak of the soldiers and sailors and police who have been "in action," so to speak, day and night for a week, and have gained in the midst of peace a victory as great as any that has altered the political face of the world. One cannot find words to fitly record, even from our limited aspect, the manifold glories of this epoch of the national history. But if every man will think out for himself the meaning of what he may have been privileged to see with his own eyes or hear from his neighbours, he must be dull indeed if he does not feel it an honour to belong to the race of those who in every capacity have wrought so faithfully, so prudently, and so triumphantly in this ever-memorable celebration of an event unique in history.

Gas Illuminations for the Jubilee.

ONE of the commonplaces of popular criticism that never fails to make itself heard in connection with such occasions as the recent jubilations is that the illuminations and "all "that sort of thing" must be "good for the gas com-"panies," who are not infrequently expected to contribute liberally to the expenses of town decorations on this account. The gift of free gas for illuminations is often suggested as a graceful act in the circumstances which no self-respecting gas company should be averse to performing. It may be as well, therefore, to remark here that, so far from being a "good thing" for a gas undertaking, a public holiday with illuminations never brings to the gas office anything better than a fall of revenue, and an infinity of trouble, anxiety, and extra work. The special consumption of gas in illuminations, however lavish, cannot, and as a matter of fact does not, compensate for the diminished consumption due to the closing of houses of business; while the obligation to give an increased temporary supply in places where proper provision for making effective use of it does not always exist is a severe strain upon the resources of the distributing department. In London and the larger cities, experience has shown the expediency of providing a special emergency service for the outside illumination of large public and commercial buildings; but the spasmodic desire of the proprietors of establishments in back streets to make a big flare on special occasions is not always consistent with the gas-distributing arrangements that answer all ordinary requirements. Last week, gas illuminations were as

popular as ever, notwithstanding the rivalry of electricity in its two forms of arc and incandescent lamps. Cut-crystal and other devices of the familiar "transparency" order were plentiful; but the massive simplicity of gas flambeaux, and the always-effective plan of outlining architectural features with small points of lights, were equally popular. There were fewer attempts than of yore in the direction of piling up huge open gas-jet displays in a vertical plane, which are liable to the disadvantage of excessive flickering of the upper lights owing to lack of oxygen; but where this defect is not too pronounced, the liveliness of gas-jets as compared with the stillness of incandescent electric lamps used in a similar way is to the advantage of the former. Altogether, it can be truly said that gas, as a means of festive illumination, quite held its own in London and the provinces last week; and the circumstance that nothing startling in the shape of a novel application of this medium has to be recorded may be taken to imply that its capacities in this regard are now thoroughly understood by professional decorators, and appreciated by the public.

Stelfox upon Claus.

In commencing this week our report of the papers and discussions constituting the transactions of the Incorporated Gas Institute with the paper of Mr. Stelfox, we are constrained to remark upon the peculiar value of such records. It is not a pleasant thing to deliberately tell the story of a failure; and it is still more unpleasant to pass such a story in review. With regard to Mr. Stelfox, however, it may be claimed for him that he has "told the truth "in love," with manifest regret that it did not happen to be a different story altogether. We do not recall, in the whole range of technical literature, so candid a narrative. How helpful it would be—how much more rapidly manufacturing improvement would progress—if only people who have tried processes in vain would follow this example, and tell the world how it happened! In the scope of the gas industry alone, how many novelties ushered in during living memory by a flourish of trumpets, have been allowed to drop out of knowledge without a word of explanation or excuse! At the present moment, it would be difficult to define the precise position occupied in average professional opinion by half-a-dozen systems or processes that might be named, and within a few years some of them will have dropped into desuetude without anybody venturing to say why or wherefore. One evil result of this conspiracy of silence with regard to dropped processes is that they are often re-invented by strenuous persons in a later generation. There never was any process that endured long enough to fail under practical trial but had some substratum of reason for its brief existence; and it is part of the nature of things for the temptation to remain while the hollowness of it gets forgotten. It is of very little use in these circumstances for an elder practitioner to ask a young inventor, say, whether he ever heard of "Dr. Eveleigh's process," or of any other anticipation that did not succeed, unless he can at the same time give indisputable evidence to show "where was the hole in the "bucket." Inventors are of necessity a sanguine race. They invariably flatter themselves that they possess the long-sought-for secret of success; and if their ideas have ever occupied an older head than their own—which is usually the case—they want to know precisely why the thing went off. Practical men, occupied with urgent affairs, are not so exigent of particulars. They see that a man has taken up with a new thing, and they leave him alone. By-and-by an occasion offers for asking how So-and-so is getting on with his fancy; and the smallest indication either that it is "coming on," or "going off," as the case may be, is sufficient for them. Technical literature, however, needs to be more exact; and such papers as this of Mr. Stelfox are precisely what is required for a permanent record.

The Meeting of the Societe Technique.

The annual meeting of the Société Technique de l'Industrie du Gaz en France was held in Paris contemporaneously with that of the Incorporated Gas Institute, under the presidency of M. Ph. Delahaye. According to custom, we give in another column a condensed account of the general proceedings, and an abstract translation of the presidential address, which was a very long composition. A large portion of the address was devoted to a criticism of the four principal methods of artificial lighting now competing for the favour of the French public. Petroleum lamps are powerful competitors with gas in France as elsewhere, and M. Delahaye gave some interesting particulars illustrating the duty of petroleum burnt for lighting by means of lamps of various descriptions, including the new incandescent variety. Artificial light of every kind is dear in France, chiefly owing to the heavy taxation levied upon the raw materials by the National and Municipal Governments. So costly is it, indeed, that M. Delahaye takes coal gas at 7s. 10d. per 1000 cubic feet as a standard of comparison for domestic lighting. Electric lighting is dearer still; but M. Delahaye willingly admits that this method of lighting has its advantages—among others, that of abolishing lucifer matches, the dearness and bad quality of which in France are notorious. Upon the vexed question of the commercial and technical prospects of acetylene lighting, the President had nothing definite to advance. Unlike the majority of his countrymen, M. Delahaye keeps a watchful eye upon what is going on outside France, and he said more in his address respecting the work of Majendie and Lewes in regard to acetylene than about any French authority. This is very remarkable, seeing how bold a bid another Frenchman—M. Raoul Pictet—has recently made for the monopoly of the acetylene trade. On the fourth subject considered—carburetted water gas—M. Delahaye spoke plainly enough. The high price of petroleum puts carburetted water-gas plant beyond the reach of French gas managers. Assuming it to be practicable to produce carburetted water gas in England at about the same cost as coal gas, the prime cost of the former would be double that of the latter in France. M. Delahaye said nothing about any possibility of getting a suitable quality of oil for gas making admitted into French towns at a reduced duty; and it is clear that nothing of the kind is to be expected so long as it could not be shown that the public would derive an advantage from the concession in the form of cheaper gas. Upon this last subject—the price of gas in France generally—M. Delahaye only touched very lightly. The public, the Municipalities, and the Gas Companies are continually at variance in this regard; and M. Delahaye was perfectly justified in complaining that while French gas managers are reproached on account of their monopoly and their tariffs, they are not responsible for either the one or the other. It is all "the system;" and when one has said this, one has said all to a people so intensely bureaucratic as the French.

The Failure of the Gas-Engine in the United States.

A somewhat uncomplimentary proverb informs us that "children and fools speak truth;" and it occasionally happens that journalists who undertake to write upon technical subjects with but a small equipment of knowledge or intelligence hit upon truths that do not appear in the published observations of experts. Thus, an American contemporary which does us the frequent honour of appropriating without acknowledgment such original matter relating to gas engineering as it takes a fancy to, has recently been commenting upon the remarkable fact that gas-engines do not "go" well in the States. Of course, it is admitted that "gas-engines as well-"designed and as efficient as any in the world are built in "the United States;" but, somehow, the trade in these beautiful machines does not develop like other trades in that great country. "Why this thusness?" as the late celebrated A. Ward would have inquired. We are informed in reply that "the causes are various. They are "chiefly to be found in the cheapness of steam coal and "the high cost of gas in the United States. No doubt "the cost of gas illumination has something to do with "the wonderful development of electric lighting in this "country; and the same cause must have operated to "develop the electric motor as against the gas-engine." Then some information is given as to the ridiculously low rates at which gas is sold in some English towns, by way of explaining the popularity of the gas-engine in England. This leads up to the notable conclusion that "when this "industry, which in respect of its proportions is yet in its "infancy, has attained the importance which it has in "Europe, it will tend to reduce the price of gas, especially "such gas as is used for cooking and power purposes; "and the gas companies themselves will undoubtedly "benefit by the growth of the industry—the increased "consumption more than compensating for the reduction "in price." Though this is a glaring example of reasoning in a circle—a kind of argument that leads to nothing—

the passage supplies evidence that the writer has a blind sort of feeling that the price of gas in the States is not what it should be, and that the gas-engine industry is under a cloud in consequence. Of course, he does not know why this is so, nor how it comes to pass that the city of Manchester is able to sell gas at "60 cents per 1000 cubic "feet," and send out more than is required for the supply of the whole State of Massachusetts. It would be useless to argue that the proper regulation of gas supply is one of those things that the American people do not understand; but it is true, nevertheless. It is bad government, and nothing else, that keeps United States gas dear, and prevents the gas-engine from subserving the public interest as it does in other lands.

Coal Nationalization at the Miners' Congress.

Not much notice has been taken by the newspapers of this year's International Miners' Conference, which has been sitting at the St. Martin's Town Hall, Charing Cross, and appears to have had an unusually pleasant and peaceful time of it. The circumstance that nothing ever comes of these gatherings except, in the usual way, acrimonious bickerings between the different sections of Socialists composing them, never prevents the leaders of the constituent Trade Unions from treating themselves to these functions at the expense of the working miner. An instructive little debate arose on the present occasion upon the motion of a French deputy in favour of the nationalization of coal mines. This is a point of policy in high favour with English miners' representatives, who never grow weary of dilating on the good time that would follow upon the transfer of all mineral property to the State. It so happens that what is only a matter of opinion in this country is a fact in France and Germany. In the former country, the experience of nationalization is peculiar. The thing was done by law in 1810, when all mines were declared to be the property of the State. The result has been, notwithstanding, that the colliery proprietors have attained more power than they enjoy anywhere else. The deputy thought that if this condition of affairs were altered once more, and the mining business placed in the hands of the State, it would be easy for the mining population to bring pressure upon it in order to make it a better employer than a colliery company. Unfortunately for the peace of the congress, a German deputy was able to refute this proposition by adducing the fact that in Germany, where there are coal mines belonging to the State, it has been found that the latter is the worst possible employer and the worst enemy and opponent of the workers. The condition of the workers in the State mines is infinitely worse than elsewhere. It is worth observing how this contact of sober fact with the airy product of socialistic imagination demoralized the congress. One speaker after another rose and floundered round the question before the meeting; and they soon began to accuse one another of inconsistency. Somebody reminded the representatives of the Miners' Federation that at the celebrated Norwich Conference they had voted in favour of the nationalization not only of the coal mines but of every means of production; and the reminder was very ill received. The German delegate had pricked the bubble, and there was an end of it in any other guise than that of a "pious opinion," for which the congress somewhat shamefacedly proceeded to vote. Seeing that two of the German miners' leaders are actually in prison for the part they took on behalf of their fellow trade unionists against the State employer—their action being on a par with much that an English labour leader and member of Parliament regards as part of his ordinary day's work—it was obvious that the theory of nationalization has a screw loose somewhere. It is to be regretted that certain other socialistic theories cannot be similarly tested against accomplished facts. The amount of such theory that would survive the ordeal would not hurt anybody.

Death of Mr. John Orwell Phillips.—We regret to announce the death, at his residence, 44, Grosvenor Street, of Mr. John Orwell Phillips, the late Secretary and General Manager of The Gaslight and Coke Company, at the age of 71. The intelligence only reached us at the moment of going to press, so that we must defer till next week giving any detailed account of Mr. Phillips's career. He had been ailing for some time, but the end appears to have come somewhat suddenly.

THE INCORPORATED GAS INSTITUTE.

PROCEEDINGS AT THE THIRTY-FOURTH ANNUAL GENERAL MEETING,

HELD AT

THE GUILDHALL, BATH, June 15, 16, and 17, 1897.

C. Stafford Ellery, Esq., Assoc.M.Inst.C.E., President.

PAPERS AND DISCUSSIONS.

EXPERIMENTS WITH THE CLAUS SYSTEM OF PURIFICATION AT BELFAST.

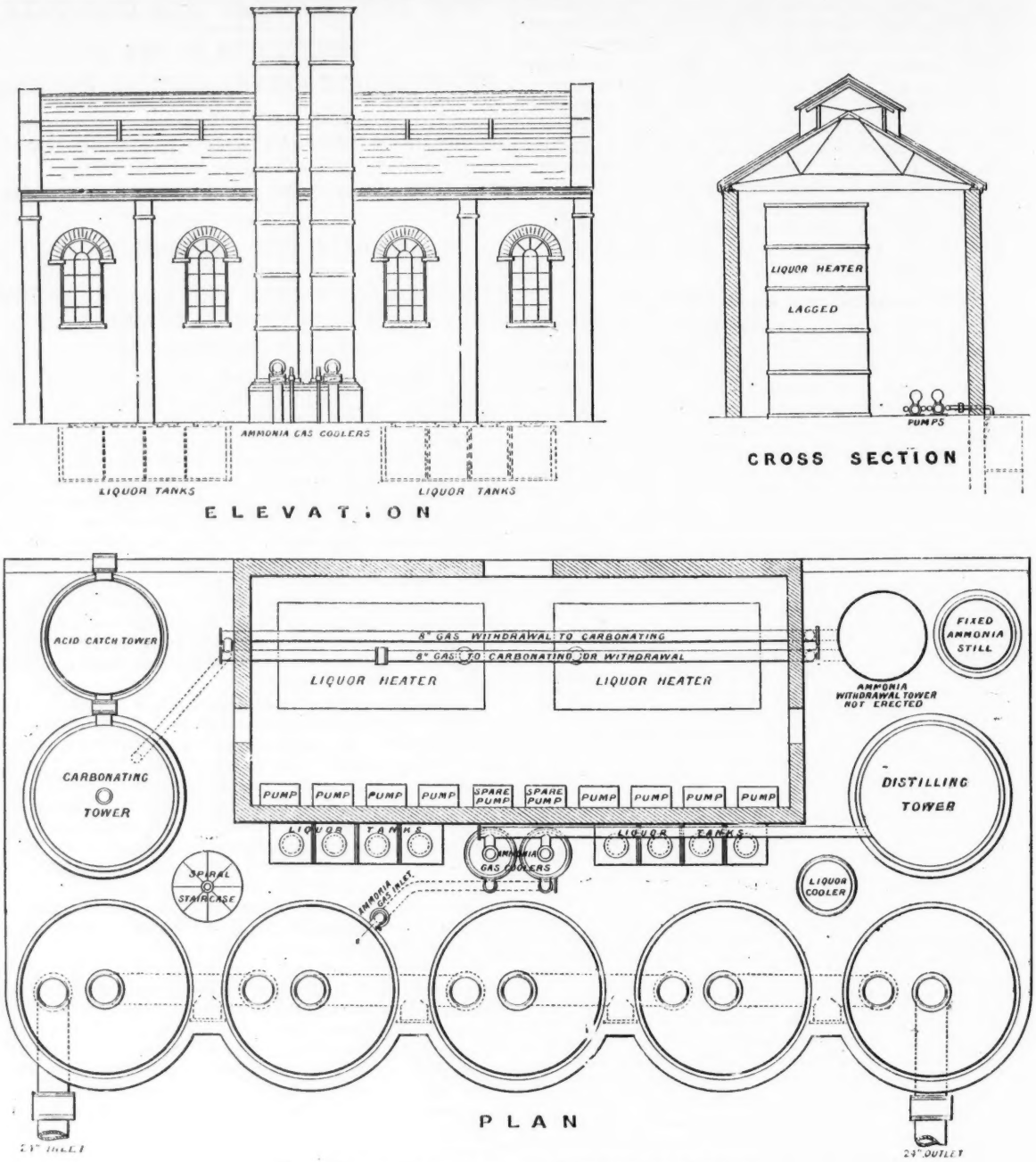
By James Stelfox, of Belfast.

In the latter part of the year 1885, we were in trouble. Paint had been blackened in the neighbourhood of the gas-works; and the general verdict of the public was that we did this "deed of darkness." Our frontage extended some 450 yards along the main thoroughfare, on the side opposite to the disfigured property; so that not only were we held responsible for all the emanations from our own works, but also for all that passed over us from adjoining chemical and other works. Vainly we pleaded that we had merely carried on the same operations as in former years, when no cause of complaint had been found. We were convicted of the offence, and ordered to pay damages to our aggrieved neighbours. Considerable feeling was excited over the subject; and possibly a slight flavouring of politics was imported, which did not tend to smooth matters.

For some time prior to this incident, a strenuous effort had been made to introduce the coal-liming process in several works; but the result had not been very encouraging to its promoters. Our trouble seemed to afford them a ray of hope; and no sooner had the news of our discomfiture been made public, than one of the chief apostles of the system took up his residence in our midst, and spent some weeks of his valuable time in teaching the inhabitants in the district how to make sulphuretted hydrogen traps. Of course, it was promised that the adoption of coal liming would be a perfect cure for the alleged nuisance; but the Gas Committee could not be induced to take it up, and the mission came to nothing.

The public feeling still, however, continued, though no further case of "blackening" was alleged; and the Committee, with my entire approval, placed the matter in the hands of an eminent expert, in order that he might report to them if anything could be done to improve the system of purification, which was blamed for all that had occurred. This step, however, only made matters worse, as the Committee were advised to attempt alterations of a wildly impossible character, which, if they could have been carried out at all, would have cost at least £80,000, and would not have answered any good purpose. In this trying state of affairs, I bethought me of a process which I had heard was being tried experimentally in Birmingham by Mr. Hunt; and I promptly decided to run across and see it for myself, and at same time learn all that was to be learned about it. Mr. Hunt received me with his usual courtesy; and under his guidance, I received my first lesson in the Claus system of purification. On my return, I at once devoted myself to a thorough investigation as to the possibility of working the system; and I found that, though I was unable to provide a site for the whole of the appliances on one side of our works, I could, by separating the purifying process from the sulphur recovery, make enough room. I also discovered that I could, by a very simple connection, arrange that the gas after leaving the Claus apparatus should pass on to our ordinary lime purifiers. This made us quite safe in case of any failure on the part of the new system, and paved the way for its adoption. Accordingly, in May, 1886, I ventured to advise my Committee to arrange for a plant which was to be calculated for the purification of 2½ millions per diem.

It will be seen that we were in a measure forced into a trial of this system, by the circumstances which I have already mentioned. It is, however, unquestionable that the Committee were greatly taken with the advantages seeming to accrue from its use, as well as with the promise



The Claus Plant at the Belfast Gas-Works.

of a large revenue which was to be derived from certain residual products. A deputation, accompanied by the Town Clerk and myself, proceeded to London to negotiate with the Ammonia Gas Purifying and Alkali Company, Limited, who had purchased the patents, for the right to use them. We formed the opinion that the Directors were a body of honourable business men, who fully believed in the practical value of their patents; and we have never had any reason to alter this view. An arrangement was effected, and everything settled except mere details. The Company not being manufacturers, nor giving us any guarantee further than the figures obtained in the experimental operations at Birmingham, we decided to prepare a specification in accordance with their ideas, and to ask for tenders for the work. It was determined not to have a patch-up plant. Accordingly everything was made new; and in respect of shape, capacity, and details, the wishes of the Company and the patentee were fully carried into effect.

The contract was entrusted to Messrs. Samuel Cutler and Sons in the autumn of 1886, on the basis of sketch plans, accompanying the general specification for the work. Some vessels originally contemplated were, however, discarded, and the construction of others changed. The elaborate system of pumps and connections had to be settled, and numberless details worked out; so that it was not until the close of 1888 that the plant was ready for work. The plans shown are those originally prepared; and in the main the work was carried out in accordance with them—the only exception being that the sulphur chambers were constructed in two storeys, the end or single chamber being placed over the two smaller chambers, which were in direct communication with the two sets of kilns.

I shall not trouble you with any elaborate description of the process, which will, no doubt, be familiar to most of you through the paper of Mr. Charles Hunt, of Birmingham, contributed to the Institute in 1886. My intention is rather to give a brief account of its working than to discuss it from a technical point of view. A short description will not, however, be out of place.

The system proposes to effect complete purification of gas by combining the acid and alkaline impurities to form soluble salts, to be taken up by water in a series of scrubbers. This process is going on every day in gas-works as far as the ammonia in the foul gas will carry it; but as the acid impurities are present in a much larger proportion than the alkaline, ammonia must be added in sufficient quantity to effect the necessary combination. This extra supply is

to be derived from ammoniacal liquor; and the apparatus may be divided into two sections, in addition to that for the recovery of sulphur. In the first the liquor is treated; and the second consists of the vessels in which the gas is to be purified. In the former is included a heater, built up of flat sections, each of which contains a steam-chamber, provided with steam from the main supply, which is regulated at will by means of a tap. The liquor, which is introduced at the top, is made to run in a tortuous course over the surface of each of these trays by means of baffles; and on reaching the opposite end of the tray from that at which it enters, it overflows on to the next plate, and so continues to the bottom of the vessel. The lower trays are kept at 195° to 200° Fahr., at which temperature a large proportion of the carbonic acid and sulphuretted hydrogen is driven off as gas, and passed on to the sulphur recovery plant. The remaining liquor is therefore principally caustic ammonia; and this is treated in a still, and the ammonia gas is taken, after cooling, to the purifying vessels, where it is mixed with the foul gas. The resultant salts being removed in the scrubbers, the gas is purified, and the strong liquor formed is returned to be again treated in the heater; so that, theoretically, there is no loss of ammonia. The gases driven off in the heater are passed through a scrubber and catch-tower on their way to the sulphur recovery chambers, so that any ammonia passing away is arrested and returned to the system.

Early in the year 1887, the Ammonia Purification Company informed me that they had decided to give up work at their Birmingham plant, and urged me to engage their chemist and their two workmen, so that we might be able to start our new apparatus with trained assistants. Mr. Watts had devoted his great ability to the development of the system from the period of its inception, and knew all that was known about it; so that my Committee readily fell in with the suggestion, and agreed to engage him in order that he might have a general control during the erection of the plant. His assistants were also employed, so that they might become familiar with all the details of its construction. Mr. Watts accordingly joined my staff in September, 1887.

In December, 1888, we made several attempts to start work; but structural defects of a more or less serious character were disclosed. This was to be expected; and the only really troublesome one was a leakage in a joint at the bottom of the liquor heaters. This joint being in an inaccessible place, it was found impossible to make it good; and the defect necessitated the closing up of the lowest tray in the heaters after considerable delay and loss of ammonia. Thus the first turning in of gas did not take place until Jan. 25, 1889. The gas, when turned on, at once showed foul at the outlet; but we were encouraged by receiving a report about the third day that it was clean. This proved to be a mistake; and from day to day our feelings were damped by a continuance of impurity in what should have been the clean gas. The extent of this failure varied from the first, not only as regards the total quantity of impurity left in the gas, but also in respect of the proportions of sulphuretted hydrogen and carbonic acid forming that total.

The following statement gives details of the working from Feb. 2 (a week after the start) till Feb. 22, when the plant was stopped for repairs. I give it to show the daily variation in the efficiency of the plant; and it may be taken as fairly typical of our experience throughout the experiments.

Date. 1889. Feb.	Gas passed through Plant. Thousand Cubic Feet.	Total Impurity.			Carbonic Acid.			Sulphuretted Hydrogen.		
		In Foul Gas.	At Claus Outlet.	Percentage of Efficiency.	In Foul Gas.	At Claus Outlet.	Percentage of Efficiency.	In Foul Gas.	At Claus Outlet.	Percentage of Efficiency.
2	2088	4·05	2·65	34·57	2·93	1·90	35·59	1·10	0·75	31·82
3	1976	4·00	1·66	58·50	2·85	1·20	57·89	1·15	0·46	60·00
4	1810	5·00	2·60	48·00	3·45	1·76	48·99	1·55	0·84	45·81
5	1564	5·00	2·80	44·00	3·84	1·97	48·70	1·16	0·83	28·45
6	1649	3·80	2·00	47·37	2·91	1·41	51·54	0·89	0·59	33·71
7	1684	4·00	0·90	77·50	2·35	0·57	75·54	1·65	0·33	80·00
8	1745	4·40	1·40	68·18	3·08	0·71	76·95	1·32	0·69	47·73
9	2093	4·80	1·80	62·50	3·52	1·00	71·59	1·28	0·80	37·50
10	2093	4·00	1·00	75·00	2·82	0·62	78·01	1·18	0·38	67·80
11	2108	3·70	1·50	59·46	2·93	0·93	68·26	0·77	0·57	25·97
12	2104	3·80	1·40	63·16	2·65	0·92	65·28	1·15	0·48	58·26
13	2126	5·40	2·40	55·55	3·70	1·30	64·86	1·70	1·10	35·29
14	2112	4·60	1·40	69·56	2·82	0·67	76·24	1·78	0·73	58·99
15	2043	4·60	2·00	56·52	3·12	1·14	63·46	1·48	0·86	41·89
16	2028	6·50	2·40	63·07	4·88	1·31	73·16	1·62	1·09	32·72
17	2016	4·32	1·80	58·33	3·00	0·81	73·00	1·32	0·99	25·00
18	2022	4·68	1·80	61·54	3·00	0·91	69·67	1·68	0·89	47·02
19	1937	5·68	2·20	61·27	4·00	1·05	73·75	1·68	1·15	31·55
20	2071	5·80	2·40	58·62	4·15	1·31	68·43	1·65	1·09	33·94
21	2063	4·10	1·00	75·61	3·44	0·70	79·65	0·66	0·30	54·54
22	1980	5·45	2·00	63·30	4·00	1·14	71·50	1·45	0·86	40·69

Average efficiency for total impurity, 60 per cent.; for carbonic acid, slightly over 66·5 per cent.; for sulphuretted hydrogen, a little less than 44 per cent.

From these figures, it would seem impossible to formulate any distinct theory. On Feb. 2, the total impurity was 4·05 per cent., of which the Claus plant extracted but 1·40, or 34·57 per cent.; while on the following day, the total impurity being 4 per cent., the plant absorbed 2·34, or 58½ per cent., of the whole. It will be observed that the efficiency of the plant as regards carbonic acid and sulphuretted hydrogen, when calculated separately, closely corresponds in each case with the total efficiency; being on the first day 35·59 and 31·82 per cent. respectively, and on the second 57·89 and 60 per cent. But if we take the two dates Feb. 7 and 8, we find a very different state of things. The total efficiency on these particular days reached 77·5 and 68·18 per cent. respectively. But taking the impurities separately, we have for carbonic acid on the 7th an efficiency of 75·54 per cent., and on the 8th 76·95 per cent.; whereas as regards sulphuretted hydrogen, the figures are relatively 80 and 47·73 per cent. It will be observed, too, that the effectiveness of the process could not be reckoned up by any regular standard of work accomplished.

In the description of the process given by the inventor and the first experimenters, it was suggested that there would be no trouble in dealing with larger or smaller volumes and variety of impurity. It was said to be only necessary to increase or diminish the speed of the various materials through the system, in order to deal with any quantity of gas or any variation in amount or character of impurity. It was, in fact, urged that, in order to effect the greatest economy in purification, only the exact quantity of ammonia necessary to combine with the acid impurities should be passed into the purifying vessels. I am not able to confirm this. My experience has been that the system may be relied upon to take out a varying—I might say an extremely varying—percentage of the impurity; but that only under few and uncertain conditions can it effect complete purification. Let us again refer to our tabulated statement. On Feb. 10, an efficiency of 75 per cent. was achieved with gas containing 4 per cent. of impurity; the quantity dealt with being 2,093,000 cubic feet. If this could be taken as a standard, we might assume that this was equal to the complete purification of 1,570,000 cubic feet. But, as will be seen, the make of 1,564,000 cubic feet passed through on Feb. 5 was not purified, and showed a much lower percentage of efficiency than was obtained with the larger quantity. Again, on Feb. 11, with a reduced percentage of impurity compared with Feb. 10, there was a considerable falling off as regards the purifying powers of the plant. The table furnishes a great number of these seeming vagaries, the causes of which were, and have remained, obscure. This uncertainty of action has been manifested in every stage of the experiments, except during the brief periods when complete purification was

effected; and the fact of our having been able to accomplish the latter at one time, while failing at others when the conditions appeared equally favourable, seems at present one of those things that are past comprehension.

On Feb. 22, as already mentioned, we had our first stoppage "to repair liquor tanks." This occupied until March 21, when the gas was again passed through the plant. The production in the section had by this time fallen to about 1½ million cubic feet per day; but the efficiency of the plant was not increased—only about 50 per cent. of the impurity being removed, and the daily variations being if anything more remarkable than before the stoppage. However, as the make decreased, a better efficiency was obtained; and on April 29, with a make of slightly under a million cubic feet, our tests showed that for the first time our gas was free from carbonic acid—the sulphuretted hydrogen being returned as 7 grains per 100 cubic feet.

At this stage, another problem presented itself for solution. The amount of ammonia in circulation was admittedly in excess of that required theoretically for combination with the acid impurities. In fact, the presence of ammonia was often observable at the outlet, along with sulphuretted hydrogen; the latter, according to the returns, varying from a "trace" to 0·66 per cent.—the variation being not only daily, but from hour to hour. As the general tendency was, however, upward, the plant was again shut down for alteration and adjustment on May 17. The principal change considered desirable was in the direction of the flow of liquor through the purifying vessels. Up to this time, the order had been 5, 2, 4, 3. 1. On re-starting on June 3, the liquor was distributed thus: 5, 4, 2, 3, 1. The make of gas was continued at about the same rate—1 million cubic feet per day—the season's reductions being made on the other section of the works. The results were very similar to those previously obtained; the sulphuretted hydrogen varying during the first fortnight from a "trace" to 0·74 per cent., notwithstanding that ammonia was always present at the outlet. Towards the end of the third week, however, there was a sensible decrease in the impurity; and on June 28, 1889, we were rejoiced to be able to write "Clean at Claus outlet" for the first time.

At last our efforts had been rewarded. We continued to send the gas through our lime purifiers as a precautionary measure; but as day after day passed without necessity for "changing," we felt like those who, having left the desert, had reached the promised land. Our hopes were somewhat damped when, on July 22, the record "Gas dirty at Claus" again appeared. This result was certainly brought about by the carelessness or neglect of the nightman in not attending to his pumps; and on July 25 we were again "clean." So things jogged along till Aug. 10, when the "black mark" had again to be put on the record. The season having advanced, the make on this day had got up to 1,277,000 cubic feet. On Aug. 13, the gas was again all right, though the make had risen to 1,325,000 cubic feet; and all went well till the 30th. The previous day's make of 1,594,000 cubic feet had been perfectly purified; and even at 10 a.m. there was a clean test. But later on in the day—probably owing to an increase of impurity in the foul gas—we had to suffer a reverse, and were once more depending largely on our lime purifiers. This spell of work was by far the best ever achieved with the plant. From June 20 till Aug. 31—a period of 72 days—no lime purifier required to be changed; and during this time 81,618,000 cubic feet of gas were purified. The reverse was speedily converted into a rout. Within a few days after the gas began to run foul, the whole system seemed to fail. The impurities at the outlet became greater each day; and on Sept. 11, with 4·4 per cent. in the foul gas and 4 per cent. at the outlet, we had to shut down again. The promised land had vanished. We had short-circuited the desert, and were back again in Egypt.

And now a spectre which had dogged us throughout all our journey came to the front, and insisted on being heard. He took the form of an irate contractor for ammoniacal liquor. From the first starting of the plant, I had been painfully conscious of the presence of free ammonia in the surrounding atmosphere; and the statements of the chemists, that the loss was very slight, but partially reassured me. I was anxious, however, to prove if the system was workable; and therefore urged upon them the necessity for taking in a sufficient quantity of ammoniacal liquor, so that a distinct "Yes" or "No" could be given on this point. The £ s. d. of the question had not so far been considered. Our residual contractor complained that his sales of sulphate had decreased by 50 per cent. during the year; and on going thoroughly over the figures, I found that our deficiency in receipts for liquor amounted to about 45 per cent. This was a serious state of affairs. Whatever there was of an obscure character about the system, one thing was clear as daylight—that it would not pay. It remained to be settled whether we should again take it up, or regard it as an undoubted failure.

The Company naturally wished to think that the failure was caused by errors in connection with the plant. The great defect alleged was the extremely unsatisfactory working of the pumps which had been provided; and it was considered certain that with a better class of apparatus there was nothing to be feared. My Committee agreed to provide a completely new installation, of better construction and larger size. It was also proposed to throw out the existing still, and substitute another; but as regards this, we did not feel disposed to incur any further expense unless the cost was shared, and our payment made conditional on the success of the system ultimately. This was finally agreed to; and the work of reconstruction, renewal, and repairs, was again proceeded with.

This overhaul occupied nearly a year; so that it was Aug. 26, 1890, before we were again ready for a start. The valves were opened on that date; but, the direct connection to the lime purifiers not being closed, little gas passed through the Claus vessels, and what came was foul. Our first trouble was the blowing of the new still on Sept. 4. This necessitated a stoppage, and we were off for a week, making alterations and deepening the seal of the still. On Sept. 11 the whole make of the section was turned through, amounting to close upon 2 million cubic feet; and the outlet gas was foul from the start. On Sept. 15, the still again blew; and the plant had to be turned off. Further alterations were made, and work was resumed on the 16th. Matters remained unchanged until Oct. 14, when we took a large portion of the gas hitherto passing through the plant to the other section of the works, to make preparation for the season's arrangements. The gas passing through the Claus plant being thus for the moment reduced to a little over a million cubic feet per day, a clean test was obtained on Oct. 16; but with an increase to 1½ million feet on Oct. 22, a dirty paper was again registered. On Nov. 5, the apparatus had to be closed down "to repair carbonator;" and this job occupied till Nov. 19, when another start was made. No further change took place till Jan. 11, 1891, when the still, which had been giving more or less trouble all along, got blocked, and another stoppage was necessitated. Four days were taken for the work. Resuming on Jan. 20, we went on in a most uneventful way until May 12, when another, and as it was then thought a final stoppage was made, which was chiefly the result of a second interview with the "spectre."

During the heavy winter months, the gas passing through the system had been in excess of 3 million cubic feet per diem; so I had no expectation of realizing complete purification by means of the Claus plant, and could only gauge its results by the percentage of efficiency obtained. This was, as before, very variable. It became clear, however, that, notwithstanding all the changes that had been made, and spite of the protestations of the chemists that there was no appreciable loss of ammonia, our revenue from this residual was suffering keenly. On Jan. 13, 1891, I wrote to the Ammonia Company to this effect. A rather voluminous correspondence ensued, in the course of which the Ammonia Company requested me to allow our chemist to proceed to London to consult with them as to the position of the undertaking, and the possibility of making it a success. It had become quite clear that, unless something in the way of improvement could be effected, the loss of ammonia alone would condemn it, even were it in other respects satisfactory.

It will be seen that Mr. Watts might be regarded as, in all respects, more the representative of the Ammonia Company than ours, during all the time the experiments were going on. This was but natural. We regarded the interests of the Company as identical with our own; and we all looked to Mr. Watts as the receptacle of all the knowledge available in reference to the system. I cheerfully pay Mr. Watts the tribute of saying that no man could

have more thoroughly worked for, and desired, the success of an undertaking than did he during the years this scheme was under trial; and I am bound to say that if he failed to make it a success, I have but little hope of anyone else succeeding. No doubt, like many a foster-parent, he was a little blind to the faults of the child of his adoption—a very natural and very amiable tendency. Feeling thus, it will readily be understood why the whole expenditure on, and working of, the plant were left entirely in his hands; and the Ammonia Company were as well acquainted with everything that was going on as we were ourselves.

However, to return to the "spectre." It appeared that the loss of ammonia during the month of January, 1891, was well on to 20 per cent. of the whole production; and the February results were even worse. The loss by this time was undeniable; and but for the fact that our limited space was bunged up with refuse lime, and we desired to reduce as far as possible the production of this residual, we should have at once shut down. Mr. Watts meanwhile reported to the Company what alterations he considered should be made to perfect the apparatus; and these were of a very extensive character. Negotiations were again opened by the Company for another complete overhaul, which was to be done at their cost, but on the condition that they should be recouped if success were achieved. They were to have complete control over the whole apparatus, and in the meantime pay all expenses. All these matters having been arranged, the plant was put out of action on May 12, 1891, and left entirely in the hands of the Company to effect such changes or repairs as they might deem necessary. As regards these changes, I took no part in arranging them, but tried to impress upon the Company the importance of having everything perfect for the next trial, as it would be most unfortunate if we had again to start and stop.

About eleven months were occupied in the overhaul and partial reconstruction of the plant. We made an unsuccessful effort to recommence work on March 25, 1892, and another on April 1; the failure in the latter case being due to the blowing of the still. On making a third attempt on April 8, things were as bad as ever. This was not a very encouraging beginning, after almost a year's preparation. Finally it was discovered that the pipe between the purifying plant and the sulphur kiln had become blocked with carbonate of ammonia. After cleaning this out, we got again to work on April 14, 1892, our make of gas on the section being just 2¼ million cubic feet. The gas was quite dirty at the outlet; and the still continued to blow periodically, with great loss of ammonia.

As regards the efficiency of the plant at this period, our purifying figures led us to a different conclusion from that arrived at by the chemists' analyses of the gas before and after passing through the apparatus. According to the latter, from 50 to 75 per cent. of the total impurity was removed. Calculated on the quantity of lime used before and after the re-starting of the apparatus, the saving did not represent more than about 30 per cent. Our daily make got gradually down; but we seemed to be as far as ever from the achievement of our wishes. The sulphur kiln began also to give us trouble. The brickwork became saturated with the condensed vapours from the kilns, and the joints got leaky; the gases passing through and causing great complaint. As it appeared impossible to improve on this state of matters, and the plant had been inefficient even with the midsummer make, it seemed useless to continue its use; and accordingly operations were again suspended on June 6, 1892. Up to this time, counting from the first actual starting of the plant to work, 1215 days had elapsed, during 475 of which gas had been passing through it; the remaining 740 days having been occupied in repairs, alterations, and renewals.

Matters had now come to a deadlock; and we practically decided to write the whole thing out of our books. The Company, however, again reopened negotiations; and as the result of numerous letters and interviews, it was decided to hand over the plant to them, to be by them put in order and operated. Accordingly, they started to overhaul the apparatus, which was not ready for work till May 12, 1893. On this date the gas was turned through; but the outlet showed a dirty test, though the quantity passed was only about 700,000 cubic feet per day. On May 21, the gas was free from sulphuretted hydrogen; and this condition of affairs continued till July 4, with the exception of one day, when it showed a dirty test. Unfortunately, the experiment had to be interrupted, in order to effect an overhaul and reconstruction of the works' mains; and on the date mentioned all the gas was turned into the other section of the works. Work was resumed on Aug. 23, and the gas was clean at the outlet; but at intervals it ran foul until Aug. 30, when a complete block occurred, necessitating a stoppage of the plant.

A week was occupied in cleaning out; and on Sept. 6 work was once more resumed with a clean outlet. From this date until Oct. 4, the second best set of results was obtained; the gas being generally clean at the outlet, though on 16 days there was a trace of impurity present. The uncertainty of action, however, was most strikingly indicated during this period; as on one day, 1,816,000 cubic feet were perfectly purified, whereas on another day there was a dirty test with a make of under a million feet. Also taking two consecutive days, the purification was imperfect with a make of 1,158,000 cubic feet on the first day, and absolutely perfect the following day with a production of 1,353,000 cubic feet; the purity in the foul gas being 6 per cent. greater on the day of the larger make. From Oct. 14, the make of gas was gradually increased; and the outlet always showed a foul test. The new carburetted water-gas plant was by this time approaching completion; and as it had been determined to pass the new gas through this system, a stoppage was made on Nov. 19 to have everything put into complete order. To keep things safe, the connections from the outlet of the Claus apparatus were laid to a new station meter; and the exhauster outlets were so arranged that the carburetted water gas could be (*a*) passed direct from the Claus plant to the gasholder through this meter, (*b*) passed through this meter by a special inlet, and after being measured foul sent on to mix with the ordinary gas for purification, or (*c*) passed direct into the coal-gas mains at the scrubber inlets.

Our first make of water gas commenced at Christmas, 1893. You will be aware that the quantity of sulphuretted hydrogen in carburetted water gas is very small—say, about 0·15 per cent. in the foul gas—and our start was a very hopeful one; the test being perfectly clean. Little troubles occurred from time to time, such as the blocking of pumps owing to deposit of pitchy material dissolved out of the purifying vessels by the new gas; and there were frequent stoppages, which with coal-gas works would have been highly inconvenient, but which, owing to the latitude in working conditions available with the water-gas plant, were safely tided over. As the autumn advanced, these little worries became more frequent and alarming; and we had to face the winter of 1894-5 with anything but cheerful feelings, as, being disappointed of the use of new purifiers on which we had reckoned, we felt that notwithstanding all our arrangements for duplicating the working mains, the available purifiers were utterly inadequate to deal with the united make of coal and water gas if it became necessary to turn the latter over to them. A most anxious season was passed; and it was quite evident that we could not continue to work the plant without a complete overhaul and partial reconstruction. Later on in the season, scarcely a day passed without some trouble cropping up; and we waited for the spring with feelings somewhat akin to those with which the crew of a water-logged ship long for the sight of a friendly sail. We had the good fortune to keep things going till Feb. 7, 1895, by which time the demand for gas had considerably fallen off. On that day, without a moment's warning, our troubles, most of which were of a mechanical sort, culminated in the collapse of the ammonia cooler. Work with the water-gas plant was at once suspended, until the necessary valve changes had been made; and when the order was given to resume, we watched our gauges with the utmost anxiety. To our great relief, we found the pressure well within the control of our syphons; and never, to pursue our analogy, did weary seamen leave a sinking ship and step upon the deck of a sound and seaworthy craft with a greater sense of relief than we felt when, bidding adieu to "purification in close vessels by ammonia," we found ourselves once more depending on our tried old friend hydrate of lime!

With this collapse ended our experiments with the Claus system of purification. I am glad to say that most of the plant has been, or will be, worked in for use; and probably the ammoniacal liquor heaters and the sulphur recovery apparatus will be the only portion not so available. The cost of working and repairs has, of course, been paid for out of current revenue.

I do not propose to attempt any speculative inquiry into the reasons why better results were not obtained. The work has been carried on throughout under the particular care of two—and for a long period three—well qualified chemists; and as they have been baffled in their investigations, it would be in vain for me to attempt the solution of so difficult a problem. A few practical items of information have, however, resulted from our labours; and to these I shall as briefly as possible refer.

As regards first cost, the claim that it is a cheaper plant must be withdrawn. Our plant cost £14,500, and was supposed to be equal to the purification of 2½ million cubic feet of gas per day. Even had it proved to be capable of performing this duty, such a cost would be much in excess of that of ordinary purifiers. Economy of space cannot be effected if we include the ground occupied by the sulphur recovery kilns and chambers. In this connection, I may say that one of the most plausible reasons advanced for the failure of the experiments was that the vessels were too small, and did not in consequence give sufficient time for the completion of the chemical process. If this theory be accepted, clearly more space would have to be occupied and greater cost incurred in attempting future installations.

To the extreme uncertainty of action, I have already referred. To this I must add that ordinary care and attention are not sufficient for carrying on the process. Those in charge must not only be trained chemists, but must also have thorough practical experience of the working of this particular plant. In case of the illness of one of the regular staff, it would be almost impossible for a stranger to take up the work, even though he were well acquainted with the theory of the system and the general construction of the apparatus. The multiplicity of the pumps—eight requiring to be in constant use—and the difficulty in keeping them in efficient working order, add not a little to the responsibility of those in charge.

Another fact seems to have been very clearly established—viz., that the analysis of the liquor in the various vessels could not be relied on as an indication of the purifying powers of the plant; and that this latter must depend on conditions unascertainable by those in charge. Thus at one time a large volume of strong ammoniacal liquor was returned to the well without affecting sensibly the stock of ammonia in the vessels as ascertained by an analysis of the liquors, while at another time a very large amount of ammoniacal liquor was taken into the plant without showing a corresponding increase in the strength of the liquors in the vessels. Hence, while going on apparently satisfactorily and unable to detect any change in the conditions of working, the subtle reactions taking place inside the vessels seemed to wear away our unknown margin of safety till, like the "bolt from the blue," came the announcement, "Gas dirty at Claus outlet." Such a condition is bad enough with ordinary purifiers; but with them a change is easily made and matters set right. No such remedy is open in the other case. The system is, for the time being at least, upset; and the only thing to be done is to endeavour to restore the conditions—apparently very uncertain in their character—under which the work had been previously carried on. Sometimes this was achieved in a day or two; sometimes—well, sometimes it wasn't!

I need hardly say how much more pleasant it would have been to me to chronicle a success rather than record a failure. I at first entertained the brightest hopes; and it was only when I realized that, notwithstanding the most skilful oversight and care, the system was not likely to be able to stand alone, but required behind it a catch system equal to the performance of the whole work in order to keep matters straight, that I somewhat lost heart and interest in it. In May, 1886, when recommending my Committee to take up the process, I referred to the closing paragraph of the chapter on Purification in "King's Treatise," in which the probability is referred to that eventually such work would be effected in close vessels, perhaps by the very ammonia contained in the crude gas itself, and said: "In this forecast of the improvements most to be desired in gas purification, the Claus system is literally described; and if its adoption is decided on, I trust and believe that the results will be in the highest degree satisfactory." In February, 1894, in a letter to a friend who had made inquiry as to how we were getting on, I wrote as follows: "Theoretically it is a very beautiful system; but in practice it seems to me that there are such numberless causes, some of them of a very trifling character, which are quite sufficient to upset the working, that I fear there is little chance of it taking the place of some of the older if less scientific systems."

In these two extracts are epitomized the results of eight years' experiments. I wish they had led me to form a different opinion. I should be glad to hear that a system which so much appeals to us as representing the theoretical perfection of gas purification could be got to work, and that someone had succeeded where I failed.

Discussion.

Mr. W. R. Chester (Nottingham) said that, as on previous occasions, they had much cause to be grateful to Mr. Stelfox for the way in which he had laid his experience before the members. The subject now treated was one which for twenty years had been of the greatest interest to all gas managers; and the determined attempt which Mr. Stelfox made ten years ago to solve the difficult problem of purification in closed vessels, had carried them to a point further than anyone had anticipated. In spite of the failures invariably met with, and in face of the conclusions now brought forward, he was bound to say that the subject still retained the same fascination for him that it always had; and if Mr. Stelfox had not succeeded in effectually purifying his gas in closed vessels, he (Mr. Chester) believed the fault lay rather with the method, and not with the principle. Twenty years ago, he remembered taking up this subject, and meeting with many of the same kinds of difficulties that Mr. Stelfox had met with on the larger scale. But he was still convinced that it would be possible to do something in this direction; and, though he would be a bold man who attempted it, he was very hopeful that at some future time they would be able to carry out this process successfully, and thus supersede the rough and clumsy methods of purification now in vogue. He thought, and hoped, the experience now recorded would only temporarily retard the time when they might look forward to accomplishing a better and more scientific method of purification.

Mr. Isaac Carr (Widnes) desired to thank Mr. Stelfox for the very clear and comprehensive manner in which he had put the working of the process before them. At the same time, he confessed to some disappointment that the crucial point—viz., the cause of the failure—had not been detected. It seemed a pity that, after so much time and money had been spent upon it, this point was not in evidence. How much was due to mechanical difficulties, or to the temperature of the gas, or to a failure in the solutions used in the purification, they were not informed. Probably it was a combination of all these three. He had the opportunity, in November, 1886, of seeing the Claus process at work in Birmingham, when it was manifest that great difficulties would be encountered, and a considerable amount of experience and skill would be required to work such a complicated arrangement. But considering the fact that for nearly three months a million cubic feet of gas per diem had been successfully purified, it seemed as if the fault could not be so much in the process as in the handling of it. He had had some experience in working out such difficulties, and knew what they were; but the fact remained that, if the process would answer for a certain period, the fault manifestly lay in the manner in which it was conducted. He was hopeful that someone would take up the problem where it was left off, and that they might arrive in the end at a workable system of gas purification in closed vessels.

Mr. R. G. Shadbolt (Grantham) considered it was quite a privilege to hear a paper so ably composed and clearly read. He recollected being at the meeting in Belfast, and looking round the arrangements there at the time; but there was such a crowd, and so many things to see, that the impression left on his mind was that it was a fad. He did not know then what he did now; and he wished to thank Mr. Stelfox very much for his very instructive paper. It was very seldom they had such a magnificent failure brought forward; but he considered it their duty to each other as gas engineers, not only to record successes, but also failures, which were not less instructive, as an apparently retrograde movement sometimes led to success. He agreed with the hope expressed by Mr. Carr that, on the results of this work, there might in the near future be reared a structure which would do honour to Mr. Stelfox, who had laid the foundation. There was an old saying that one might lead

a horse to the water, but could not make him drink; and this was a somewhat parallel case. One might have every element of success from the theoretical point of view; but beautiful as the process was theoretically, it appeared that the different bodies could not be made to combine with any regularity. This brought home to them more than anything that the manufacture of gas was a most complex business, and that there were many things connected with it of which they were entirely ignorant. It might be a humiliating confession to make; but nevertheless it was true. Having once obtained good results, if the same conditions could be procured again, there was no doubt the same results would follow. Where they were in the dark was as to what those conditions actually were; and time and further research alone could reveal them. It struck him very forcibly that the paper showed the necessity of every member systematically recording the results of his experiments and observations. Much time was lost for want of such systematic records. The great tendency was to record that which was favourable, and to omit all reference to failures. But it was undoubtedly the wisest plan to do as Mr. Stelfox had done—to record all that took place, whether favourable or not; and then, at the end of perhaps ten years, they might have something to bring forward which if it were a failure would be a magnificent one. If it were not trespassing too much on the author's good nature, he should like to ask what the outlay incurred was per 1000 cubic feet of gas purified. It was evidently an expensive experiment, and one which few could indulge in to the extent now narrated.

Mr. W. Prince (Stoke-on-Trent) wished to say how very grateful he felt to Mr. Stelfox for his admirable paper. He himself happened to be one of the unfortunate sufferers from an experiment; being practically burdened with an annuity of £100, on account of a failure in connection with the Brin's oxygen process of purification. Mr. Stelfox was to be admired for what Mr. Shadbolt had termed his "magnificent failure." If more failures were brought before the gas world, he thought that small works would be saved from attempting to justify various theories which had been advanced. Mr. Chester thought the present method of purification a crude one; but his own opinion was that it was a scientific mode. Mr. Carr's remarks he did not regard as altogether charitable. He thought that, after a failure, a man should be given credit for his experience; and he did not believe that Mr. Stelfox's experiments had failed for want of either tact, ingenuity, scientific knowledge, or capital. Personally, he felt indebted to Mr. Stelfox for bringing forward a paper which showed an idea exploded; and he thought there were many younger members of the fraternity who would, like himself, take to heart the experience which Mr. Stelfox had given.

Mr. T. Bower (West Hartlepool) said there could be no two opinions as to the admirable way in which Mr. Stelfox had brought forward this subject. To him it was quite as interesting as if Mr. Stelfox had been recording a series of elaborate and brilliant experiments which had all proved successful, as it not only showed the perseverance of Mr. Stelfox in coping with this matter as he had done, not for a few months, but over a long series of years, during which he must have taken a vast amount of trouble to collect the information now put before them, but it also displayed his manliness in recording so emphatically what seemed to be a gigantic failure. Personally he (Mr. Bower) had no experience of purification in closed vessels. But he had some experience with the Claus process of sulphur recovery in connection with the manufacture of sulphate of ammonia; and there were several statements in the paper which he could corroborate as being applicable to his own sulphur-recovery process. It was introduced to him some seven or eight years ago; and he was promised in its introduction a veritable gold mine, in addition to which there would be very great advantage from a sanitary point of view. It was the later recommendation which weighed with him more than the former; the surroundings of their works being such that they were bound to use all possible means to prevent any nuisance. On these grounds, he introduced the Claus sulphur-recovery plant; and it acted fairly well from that point of view, except at times of starting and letting down the plant, when, as Mr. Stelfox mentioned, most of the brickwork, having become saturated with condensed vapours from the kilns, expanded and became open, so that gas passed through. This seemed to be a weak point of the process, as, until the defects could be repaired, the works became an intolerable nuisance. As to the manipulation, he did not know that he could add very much. There was, however, one feature of the process which was very erratic. The sulphur recovered, which generally contained a percentage of 82 to 86 of sulphur, realized as low as 10s. and as high as £4 a ton; and he had never been able to understand why there should be this great difference in price. From a monetary point of view, he should say they had recouped themselves on the capital outlay, possibly to the extent of 5 per cent.; and with this return he was satisfied.

Mr. T. Glover (West Bromwich) thought the points of the paper had been well brought out in the discussion. He noticed the reason Mr. Stelfox took up the process was not so much to reduce cost, as to do away with the nuisance involved in the revivification of the spent material. There was no doubt they all believed it would be an ideal system to purify in closed vessels; but it appeared that it was an ideal not to be realized just yet. It was well to remember that at one works in the country a great deal was done to bring this about in a very simple manner, with the use of purified caustic ammoniacal liquor. He referred to Mr. Holgate's experiments at Halifax. Mr. Holgate had done it with a certain amount of success, though he did not aim quite so high as Claus did in the development of the process which had been described in the excellent paper to which they had listened.

Mr. William Carr (Stalybridge) said that, along with his brother, he went to see the experimental plant that was in operation at Birmingham in 1886; and he afterwards took part in the discussion of the paper on the subject read at the London meeting of that year. He then fell in love with the process, and believed the possibilities of it were very great. But he saw at the time that there would be serious difficulties of a mechanical kind; and he was somewhat found fault with for speaking of the way in which the pumps would get out of order, even if duplicates were provided. As Mr. Stelfox told them that morning, there was no doubt the difficulties were quite as great as he had anticipated; and sometimes the second pump got out of order before the first one was repaired and ready for use. He felt some regret in having to take part in what seemed a kind of obituary ceremony over this process; for he could not help thinking that Mr. Stelfox had pretty well wound up the Claus system. The fact that he had been able to purify for a certain period, and get the impurities out of the gas, was certainly very important; but the chief point in the paper, which seemed to have been altogether ignored in the discussion, was the appearance of the "spectre." It always struck him that in analyzing liquor at a temperature of 190°, there must be considerable loss of ammonia in evaporation. They all knew that there was evaporation of ammonia from the liquor, even at normal temperature; and if it were heated up to 190° or 200°, how much greater must be this evaporation? He therefore feared there would be great difficulties in the way of the process becoming a commercial success; and if it were not, no matter how pretty it might be in theory, or how successful on a small scale, it was of no use to gas manufacturers. They were much indebted to Mr. Stelfox for his candid description of the failures of the process; and if it ever were to survive, this paper would be the cause of its resurrection. There was more to be gained from a candid record of difficulties and failures than from a great many recitals of successes. Those who had listened to the description of the advantages of patents from the patentees themselves, must know how thoroughly worthless these statements were; and very often papers took the form of a recital of that kind. Mr. Stelfox had laid them under a debt of gratitude for his perfect candour with regard to the process. He (Mr. Carr) was so much in love with it, that he was one who had written to him more than once with regard to the progress he was making; and he felt great regret that the experiment came to so lamentable a conclusion. If there was anything to be done with the process, this was surely a challenge to those who felt they could do better, or for those who owned the process to prove that it could be made commercially successful. He believed the real defect was shown by the loss of ammonia. He agreed with Mr. Chester and others that the difficulties of purifying gas could be got over; and even Mr. Stelfox would admit that, if circumstances had permitted and time had allowed, these difficulties might have been overcome. But the loss of the ammonia was a very serious defect

and he feared, therefore, that the process would have to be abandoned.

Mr. E. C. Riley (Swindon) said he should like to bring the discussion to a practical point. There appeared to be two different views as to the cause of the failure at Belfast. Some gentlemen held somewhat to the idea that such an ideal system as the one referred to in the paper ought to be brought into the region of practical working; and it was certainly their duty and interest, as an Institute, to try and bring ideals into practice. They had in connection with their body a Research Committee; and he thought it might be worth while that questions of this kind should be referred either to the Council or to the Research Committee, so that, after due investigation, the Institute might have the benefit of some definite suggestion.

The President said the paper brought out one point very clearly—namely, that a great deal was gained by members having the courage to come forward and make known their failures. Whether from lack of courage or from excess of modesty, there was unfortunately a reticence very often in recording failures. Mr. George Livesey read a remarkable paper some years ago on failures in gas-holder construction; and certainly these papers did help members very considerably by showing what to avoid. In a place like Bath, any process for purification in closed vessels was very fascinating; and he only wished Mr. Stelfox could have said that this was a decided success. It was probably the dream of every gas manager that the day would come when purification could be done without opening purifying boxes; and perhaps what had been said that day might stimulate those who still believed in the Claus process, into fresh efforts to bring it to a success. They must pay a tribute of admiration to Mr. Stelfox for his patience in pursuing the experiment so long.

Mr. Stelfox, in reply, thanked the members for their patience in listening to so long a paper. Mr. Chester said he believed in the theory; but at the same time, he thought he would be a bold man who would now take it up. He believed in the theory still, as he always did; and it was very beautiful. He remembered being told by Mr. George Livesey that he was a bold man for taking up the Claus process; and he said he should not have had the courage to do so but for the fact that he was going to pass all the gas through the main purifiers, and therefore, whether he succeeded or not, he was safe as regarded purification. Only under these conditions could he have continued the experiment. They made arrangements by which they could pass the gas direct to the meters, if the system had proved successful. The theory was simply beautiful; and he was very sorry that the difficulties which had been referred to in the paper had prevented it being equally successful practically. He would also echo the sentiment of Mr. Chester, that he fully hoped this failure would not retard the system very long; for no one would be more delighted than himself to find out where they had made mistakes. Once this was ascertained, they might be able to go back on it; but someone else must take the next step. He did not think he could assume the responsibility of carrying the experiments any farther. Mr. Isaac Carr truly said the point of failure was not in evidence. He had been in continual conference with three experienced chemists; and they could not tell where it was. But, though his experience was not encouraging, he hoped someone else would take the matter up, and that they might gain further information. He could not give the cost of purification separately, because it had always been going on under the two systems concurrently; and he had not been able to place a value on the daily percentage of efficiency achieved by the plant, and could not therefore go into the figures in detail. Their purification for two or three years before taking up the Claus apparatus, cost 0·53d. to 0·58d. per 1000 cubic feet; and after adopting it the figure rose to 0·75d., owing to the necessity for the dual purification. If the system had been otherwise successful, with a very large make of gas it ought to be economical. The difficulty was that, in coming down to a small make, one could not reduce the staff. The staff must be there whether the quantity was large or small; and though it was not numerous, still it was an expensive one. Then he must say they were promised residuals which were not obtained. On one occasion, they sold about 60 tons of sulphur, some of which they had provided in the first place; and this was the only money they ever got from any residual product. With regard to the pumps, he well recollected Mr. Carr referring to this matter in 1886. They at that time proposed to duplicate the pumps. Mr. Samuel Cutler suggested to him a modification of the arrangement, which was shown in the plans, by which each of the eight working pumps was connected, both by suction and discharge, with several vessels, in addition to the one for which it was primarily fixed; so that in case of a breakdown of one pump, the supply of liquor could be obtained from several of the other working pumps. In addition to this, there were two pumps in the centre that were connected by inlet and outlet to the suction and discharge pipes of every one of the series of pumps. By this means, there was much more than duplication; but nevertheless it was at times difficult to keep things going. Then the action of the liquor on the piston-rods of the pumps was very bad; and they tried a great many metals before getting one which would stand. The loss of ammonia did not result so much from what Mr. Carr referred to, but from what might be put down under the general term of "spillage." Every time the piston of the pump came out, there was steam, which was noticeably full of free ammonia. Then the drain-taps of the pumps were constantly losing ammonia; and there were other similar sources of loss by leakage in various parts of the system. Anything in the way of ammonia which passed upwards from the lower trays of the liquor-heater was, he thought, arrested by the cooler liquor in the upper trays; and if any trace succeeded in getting past the heater, it was taken up in the catch-vessels outside, and then returned to the system.

ON COOKING BY THE AID OF GAS, AND THE VENTILATION OF KITCHENS.

By William Sugg, of London.

The celebrated M. Jules Gouffé, who was *Officier de Bouche*, or *Chef de Cuisine*, to the Jockey Club of Paris, in his seventh edition of the "Livre de Cuisine," published 1888, says, in speaking of roasters and ovens, that he avails himself of the opportunity to "recommend very particularly the gas-kitchener, from which one can obtain such excellent results when one wishes to make use of a regular and continuous heat." He also says: "I regret that this new invention should be at this time so little known, and that its high utility for certain uses in cooking should yet be so little understood. . . . The gas-kitchener possesses also the advantage of taking up so little space—an advantage not to be disdained in so many middle-class kitchens."

This strong recommendation of the distinguished *chef* reads to us perhaps a little strange, considering that it is now probably more than forty years ago since the brothers James and Thomas Sharp, of Southampton and Northampton, together with Mr. Alfred King, of Liverpool, first advocated the use of gas for the purposes of cooking. Not only did they advocate its use, but they actually put it successfully into practice, and illustrated its marvellous adaptability for the purpose by lectures and demonstrations all over the kingdom where gas-works were established. Some of their inventions are in use at the present day; the work done by their apparatus being but little, if at all, inferior to that done by the modern gas-kitchener. The author of this paper received from Mr. James Sharp his first lesson in the use of gas as a means for cooking food about 35 years ago at Southampton.

Now, seeing the extraordinary success which has of late years attended the efforts of gas companies throughout the kingdom to introduce gas-cooking apparatus to the public for the purposes of preparing food, it is quite clear that these gentlemen were not, as it is believed some at the time considered them to be, simply amiable fanatics, when they spoke as warmly as they did of the great advantages which the general public would derive from the use of gas in this direction. The regret of M. Jules Gouffé, in 1888, that the gas-kitchener was so little known at that time, is an eloquent panegyric on the labours and far-sighted intelligence of the pioneers of cooking by gas. The author has, from his earliest infancy to the present time, been accustomed to eat meat, pies, tarts, bread, cakes, &c., cooked entirely by the aid of gas. His father having been in the habit of seeing much of the brothers Sharp, had made for himself, after their instruction, a "gas-cooking stove"—as it was then called—of tin plate,

in which meat was roasted and pies and tarts baked with a degree of success not to be surpassed by the "cookers" and "gas-ovens" of the present day. Indeed, there is at the present moment in daily use on The Gaslight and Coke Company's premises, a kitchener made by the late William King, of Liverpool, which is difficult to excel. It is, therefore, safe to say that the greatly extended use of gas apparatus for cooking will exercise in the future a notable effect on the health of the general public, both of high and low estate, greatly in favour of comfort, economy, and longevity, and that it will be recognized that one of the greatest blessings enjoyed by the people of to-day is that resulting from the labours and inventive talent of James and Thomas Sharp, and of Alfred King, of Liverpool.

It does not appear to an ordinary man, whatever his station in life may be, who roams the fields either as a hunter or a field labourer, or who habitually works in the pure air of the country, what an important thing it is to have his food, no matter how plain it may be, properly cooked. Nature, fresh air, and hard manual work, will do a very great deal to prevent such men from knowing what indigestion is. But to the dwellers in towns and cities, who are for the most part engaged in sedentary work, it is a different thing altogether. Health, strength, and the enjoyment of life, are largely dependent upon the manner in which food is prepared. Thus, for example, a joint of beef or mutton roasted before a big blazing fire by a cook who understands how to do it, is a most enjoyable and healthy food. But joints equally good will be quite another thing if they are baked, for example, in an iron oven alongside a coal-fire, which at one time makes the sides of the oven red hot and overheats the fat and juices, and at another stews the meat until all the nutriment is sweated out of it. This latter is most commonly the food which is placed before the majority of town dwellers who do not use gas-kitcheners.

Not only the poorer classes, who have only a steak or a chop to be fried in an iron pan over a smoky coal-fire, but the middle, and even the upper, classes have their food rendered positively unfit to eat, through the manner in which it is cooked by servants who do not know how to cook, or who have not the time to see after the process of roasting before a coal-fire or in a modern coal-kitchener. The result of eating this improperly cooked food is almost continuous indigestion, coupled with a most costly method of preparing food.

It is only when one goes deeply into the matter that one realizes how extremely costly is the ordinary method of cooking food by a coal-fire by those who are not professional cooks. For example, a joint of 10 lbs. weight may be put into the ordinary coal-oven; and when taken out after it is cooked, it will be found to have lost at least one-third of its weight. The results of trials made by the Smoke Abatement Committee in 1882 show conclusively that this is very commonly the case even in competition trials with coal-kitcheners. The nourishing juices of the meat have been stewed out of it, the fat is decomposed, and the gravy is spoiled by the irregularity and excess of the heat, and sometimes by ashes having fallen into it. The dripping is discoloured, and consequently not a tempting article of food. Taken altogether, the really eatable part of the meat is only a small proportion of the weight of raw meat which was originally put into the oven. And then, the fat and juices of the meat having been overheated, or having been too long cooking by slow heat, the food does not properly digest; and in time the digestive organs are seriously impaired through the diurnal habit of eating badly-cooked food.

By means of a long series of experiments, the writer has found that there is a proper time and temperature in which meats—such as beef and mutton—should be roasted, if it is desired to eat them at their best. For example, a joint of beef weighing 10 lbs. is best when cooked at the rate of about 6 lbs. per hour; the temperature never being allowed to exceed 450° Fahr. at any time. The roaster, of course, should be first heated up before the meat is put in. Then the gas should be turned on full for ten minutes, to give a sharp heat so as to seal up the pores of the meat; and afterwards it should be reduced so that it will not exceed 450° at the end of the cooking. The author has the best reason to believe that every expert roast-cook endeavours, as far as he can, to realize these conditions when he is roasting a joint before a coal-fire; but not having perfect control over the fire, he has frequently to have recourse to expedients (such as covering the meat up in paper for a time, or putting it farther away from the fire, &c.) to obtain the result which it is so very easy to secure with a gas-kitchener.

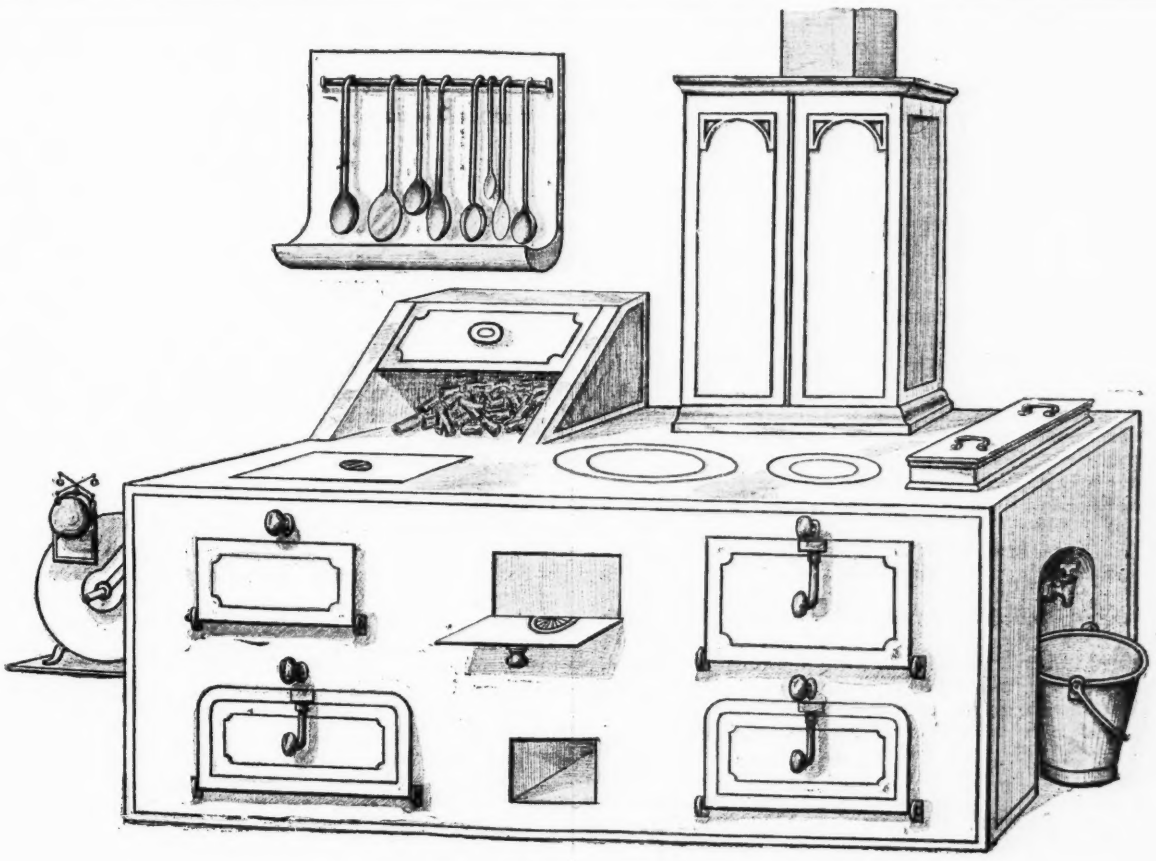


FIG. 1.—THE GOUFFE STOVE.

By the use of the latter, the joint, when served up, is appetizing to look at, plump, and brown. When cut into, the rich juices flow out into the dish; and the meat is tender and digestible, although thoroughly cooked. The loss in weight is really only the watery particles. The gravy is clear and bright; and the dripping is wholesome and useful. Thus the actual loss in weight by cooking does not exceed 10 to 12 per cent. at the outside.

Now, therefore, it is clear that, for the majority of town dwellers, who cannot, in the nature of things, have any other than ordinary female servants to prepare their food, the advantages of cooking by gas are so enormous that, even if the gas cost 5s. or 6s. per 1000 cubic feet, there still remains a saving in money, in addition to an improvement in general health, to those who adopt it. It must be remembered that if the loss in the weight of meat is reduced by only 10 per cent., it means a saving of from 10d. to 1s. in a 10-lb. joint; while the cost of gas to cook it—at, say, 5s. per 1000 cubic feet—cannot exceed 3d. at the outside. When it is a question of cooking game—such as pheasants, partridges, wild duck, snipe, and woodcock—of course, the question of cost of gas does not appreciably enter into the calculation, because in an ordinary household unprovided with a gas-kitchener it is almost impossible, even with a good general cook, to avoid spoiling many pieces, though they may not be so spoiled as to be unfit to eat. But the nutriment to be derived from game of any sort is in proportion to the degree of perfection attained in the cooking of it.

It will here be as well, as M. Gouffé has been quoted, to show the kind of *fourneau* or stove which he and most French *chefs* use in their work (see fig. 1). It will be observed that the whole of the construction is in brick; the doors of the ovens only being in iron. It consists of a hot-plate heated by charcoal. The heat of the fire is conducted all over the under side of the hot-plate, and round the different ovens. At the left side of the hot-plate is a griller, for cooking chops or steaks over charcoal. At the back of the hot-plate is a plate or dish warmer; and at the right of the stove is a boiler. On the left side of the stove is a roaster for chickens, pheasants, partridges, &c. Fig. 2

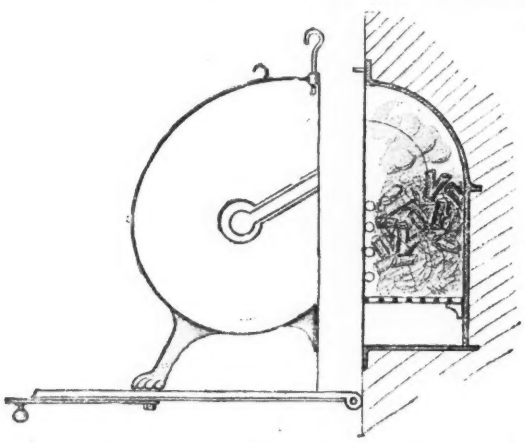


FIG. 2.—THE GOUFFE ROASTER.

is a side view of this part of the apparatus. The charcoal is placed in the small fireplace, and the meat turned in front of the fire by a clockwork turnspit. It is roasted by radiant heat. The products of combustion (carbonic acid) escape into the kitchen. Some of these stoves are used in Paris with broken coke or coal instead of charcoal.

The regulation of the heat to any saucepan or *casserole* on the hot-plate is made by moving the vessel nearer to, or further from, the source of heat. This gave rise to the phrase frequently used in French cookery-books "*le coin du fourneau*" which means a slight continuous heat. M. Gouffé also speaks of the *feu de marmite* (fire for soup-boiler), which requires to be particularly soft and continuous. There is also the *feu de grillade*, which ought to be very equal at all points and strong; and the *feu de rôti*, which he says should be a well sustained fire from the commencement to the end of the roasting. M. Gouffé lays the greatest stress on the importance of having all the vessels and the utensils kept in the most scrupulously clean state; and he remarks that he once found that the apparatus and utensils in a nobleman's house were in a disgracefully dirty condition inside, though bright and clean on the outside. There are certainly many places in London that the author has himself seen, where the gas-ovens of the kitchens were so dirty that it must have been an impossibility to cook anything in them without ruining its flavour.

It will not be denied that the apparatus here illustrated is excellent and well designed to be used by a professional *chef;* and when the modern gas-kitcheners are compared with it, it is evident that they are designed on somewhat similar lines, though they are not arranged exactly in the same way. In many respects, the arrangements of the gas-kitchener are superior to the French model. For example, the enamel-lined ovens are much to be preferred to iron or brick-lined ones, excepting perhaps for pastry. But even in this matter, the exact regulation of the heat enables one to turn out the finest pastry and bread, which cannot be excelled by such an oven as M. Gouffé speaks of. The griller of the French model is, in the opinion of connoisseurs, more perfect for doing *côtelettes* or *chateaubriands;* and it is said that the flavour imparted to the meat by the charcoal is superior to that of the gas-grilled meat. But this depends very much on the degree of heat reflected by the grill, and whether it is sufficient or not; otherwise it is difficult to see how the carbonic acid produced from the combustion of the gas is practically different to that produced from charcoal.

In the rotary roaster, however, there is a remarkable difference between the modern gas-oven and the roaster shown by M. Gouffé; and the difference is considerably in favour of the latter apparatus. Roasting the meat horizontally spitted, and kept turning before the fire, is doubtless the most perfect way of roasting; and gas, because of its complete regulation, can do this, with less attention, better than an enormous fire can do it. But it is the rule in this country to place the meat in the gas-ovens on a grid, or suspended from the roof of the oven. In this way, the juices settle down into the lower part of the joint, and leave the upper part dry, notwithstanding frequent basting. In the horizontal position, and kept constantly turning, the meat is basted by its own fat, and the nutritious juices are kept in it. In fact, it must be admitted that in this respect the old-fashioned system of roasting meat on a horizontal spit produces better results than can be obtained from the ordinary gas-kitchener.

An amusing instance of the general belief in the superiority of the old system was told to the author by a gentleman who holds a very important office in the largest gas company in the world, and who is very much interested in promoting the use of gas for cooking. He was on one occasion dining in a restaurant of great repute for the excellent quality and cooking of the meats served up to the customers. The party consisted of a number of gentlemen engaged in the manufacture of gas-kitcheners, who had met together on some business connected with their calling, and had very properly adjourned for refreshment. They enjoyed their dinner very much, and praised especially the roast. The gentleman referred to said to the head waiter: "You must have an excellent roast-cook here. My friends have very much enjoyed the roast meat, which is really cooked in first-rate style." "Oh! yes, sir," replied the waiter, "we have a first-class cook. But that is not all; the secret is we do not put any of our joints into those —— (big "D") gas-stoves"! Whether the gas-kitchener gentlemen were pleased with the joke, the author does not know, not having been present; but of this he is certain, that no properly constructed gas-kitchener ought to be outdone by any other sort of cooking apparatus whatever.

A gas-kitchener should be, and can be, the most perfect apparatus for cooking food of any kind; and the regret expressed by M. Gouffé in 1888 that its high utility is so little known, is shared by the writer of this paper to-day.

Pastry and bread are two very important branches of cookery, because they exercise either a beneficial effect on the general health of townspeople or the reverse, according to how they are made. A properly constructed gas pastry-oven will enable a pastrycook to produce the most perfectly baked pastry, such as no coal-oven can equal, because of the perfect control which the cook has over the degree of heat required for the different kinds of pastry he has to make. As a proof of this, the writer is able to say that one of the largest makers of game pies and pastry of all kinds in London now uses exclusively gas-heated ovens in place of those illustrated in M. Gouffé's book. Several of the high-class Parisian pastrycooks are now using gas-heated ovens for their finest work. It is certain that

persons whose digestion would preclude their eating pastry cooked in ordinary ovens, can easily digest such pastry as may be cooked in those ovens heated by gas. The adoption of such ovens by the Parisians, with gas at double the price it is in London, supports the truth of the statement that the excellence of the results obtained more than counterbalances the cost of gas.

One very important matter in regard to cooking in connection with pastry, fruit pies, tarts, and fine pastry generally should not be lost sight of, and that is that the crust absorbs very readily the odour of any meat or burnt fat in the oven at the time the pastry is being cooked. Therefore the greatest care must be exercised to keep the pastry-oven clean, and free from burnt fat or grease on the sides. The author does not pretend to know what the illustrious M. Gouffé would say if he saw—as is very commonly seen nowadays in the circulars of the makers of gas-kitcheners—beef, fowls, pies, and tarts packed into the same oven in a manner to simulate a Chinese puzzle. It is not generally known that fat has the property of greedily absorbing odours, and it is this property which is advantageously made use of by distillers of fine scents to obtain the odour from flowers, &c. For this purpose, the flowers from which the odour is to be extracted are placed in fine fat; and when they have given off all their scent they are removed, and the odour extracted from the fat by the process of distillation or otherwise. *Verb. sap.*

A great deal of cooking is now done by steam; and here, again, gas comes in as superior to coal or coke for the purpose. A boiler under 20 or 30 lbs. pressure of steam is not, the writer thinks, a proper or a safe apparatus for a cook to use. And even with such a pressure, dry steam, which is essential for good steam-cooking, cannot be secured; and the potatoes, puddings, and meat are more or less sodden, according to circumstances. But with gas as a source of heat for the purpose, a much better effect is produced with the minimum of risk. No higher pressure than 1½ lbs. to the square inch is required; and the steam in the ovens is always dry—the products of combustion of the gas which causes the water to boil and produce the steam, being used to jacket the chambers in which the steaming is done (as shown in fig. 3). These products are

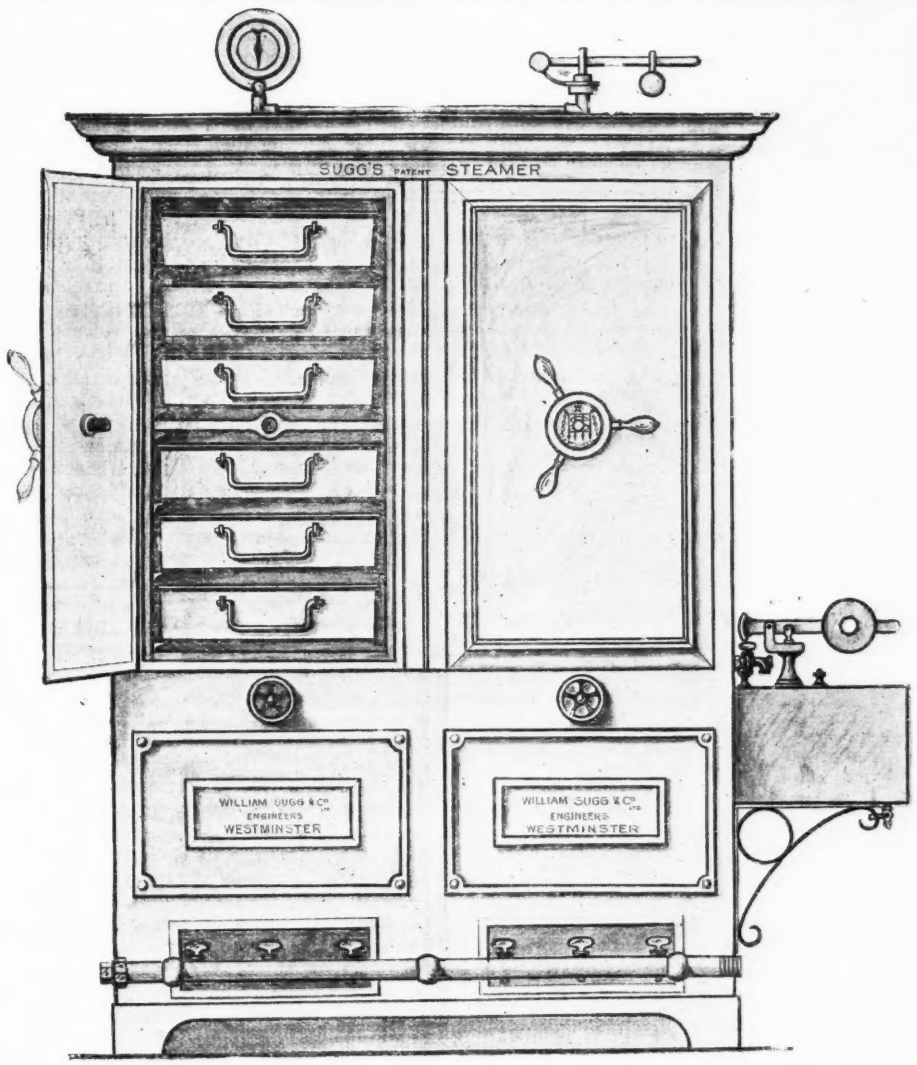


FIG. 3.—GAS-HEATED STEAM COOKER.

always from 300° to 400° in temperature; and therefore the steam is superheated, and does its work better than when it is under heavy pressure.

The extended use of gas in kitchens involves the question of ventilation. With the ordinary coal-kitcheners, which are in many cases put under the chimney apron, a very great amount of heat is radiated into the kitchen; and in large kitchens—such as are found in mansions and country houses—the products of combustion escape into the chimney, though there is a very great amount of radiant heat consequent upon the fact that much more coal is consumed than is really sufficient to produce the amount of heat required to cook the food. Gas being a fuel composed principally of hydrogen and marsh gas, and but little carbon, there need be only just enough used to produce the degree of heat required in the different cooking utensils; and there is not therefore so much heat produced in doing the work. But the products of combustion—which are steam and carbonic acid—are generally allowed to escape into the kitchen, especially in large places. From the circumstances of the case, this cannot be avoided. But, here, again, gas comes in as a means, and a cheap and good

means, of ventilating the kitchen. And it does it in the very best manner. Opening a window is not a good method of ventilation, though it is sometimes a very effective one, if there is a place into which the vitiated air from the kitchen can be driven by the inrush of air—for example, if it can be driven into a staircase. It is noticeable that in many houses there is a strong smell of the kitchen pervading the staircase and hall, showing that the ventilation of the kitchen is not properly carried out.

Other means of ventilating equally crude are sometimes tried. Ventilators, with wonderful twists and baffles, to prevent the air from blowing down instead of going up, are frequently to be seen. But however they may be made, it is a fact that in a cold still atmosphere, as well as in a hot still atmosphere, neither of these ventilators nor even open windows are of any use at all to take away the heated vitiated air from a kitchen. In cold weather, the weight of the cold air overcomes the upward tendency of the warm air. In hot weather, there is no movement at all excepting a tendency to down-draught. But if a jet of gas is kept burning in a properly constructed ventilator, a constant up-current is always secured in hot or cold still weather.

When there is plenty of wind, almost anything in the shape of a ventilator will act; but when there is no wind, only the gas-ventilator will work. Of course, it will be said by the advocates of mechanical ventilation by electric fans, that these act in any weather. The writer does not deny this; but it is well known that an electric or any mechanical fan must be kept going at full speed, or its effect is almost *nil*. The gas, on the contrary, can be

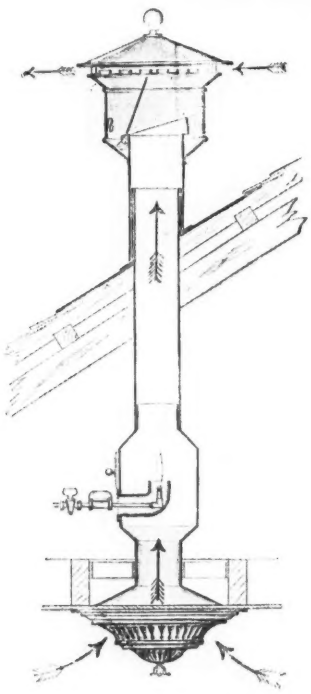


Fig. 4.—Sugg's Gas Ventilator.

easily increased or diminished according to the requirement; and the ventilation can be thereby accelerated or retarded as the need may be. Two cubic feet of gas per hour properly arranged will exhaust in a 12-inch gas ventilator over 2000 feet per hour in a still atmosphere. Fig. 4 is a view of one of the author's gas ventilators. The arrangement of these ventilators must, of course, be suited to the kitchens in which they are to be used.

In conclusion, we are far from being at the end of our tether in the improvement of gas-kitcheners; and perhaps in the near future we shall not have to express the regret that, in the interest of the public, they are not more generally known.

Discussion.

Mr. S. W. Durkin (Southampton) said, like other gas managers, he was much interested in gas cooking operations—perhaps more so than many, because his old friend and immediate predecessor, James Sharp, was a great enthusiast in gas cooking; and he was glad to hear him referred to. Another name, however, had been left out—Mr. Ebenezer Goddard, of Ipswich, who introduced the East Anglian gas-cooker. These gentlemen were on very friendly terms; and he recognized the old form of stove which was now shown, and which he saw when he joined Mr. James Sharp at Southampton, when quite a lad, in 1852. He still used in his house a similar arrangement, with the addition of a jacket outside, and an extended base so as to get the full area of the oven for roasting purposes. This had been in use longer than he cared to say. It was not quite the sort of range for present-day use, because they wanted something stronger to let out on hire. They were now made of cast iron; and yet they sometimes came back in a most abominable condition—in fact, he thought if some people could only see the utensils in which their things were cooked, they would not care to eat them. Only the other day he saw a returned stove which was reeking with filth. He was obliged to Mr. Sugg for referring to his old friend Mr. Sharp. If he had only left some manuscripts, an interesting historical account of gas cooking might have been prepared from them; for he recollected well his stumping up and down the country lecturing on the subject. He had seen him at the Literary Society at Southampton cooking a supper while delivering a lecture. He would have a stove on the table, and a boiler for generating steam, and would cook the vegetables and fish in the steamer; and to the horror of some of the ladies present, he would even insert a red herring or an onion. But the food came out without tasting in the least of either. Passing to gas cooking, Mr. Sugg had touched on an important question—that of ventilation. Gas-ranges were sometimes put into places where there was hardly room to move. But consumers had to face the cost of fixing up a range; and if they asked them in addition to put in a ventilator, he feared they would have to take the range away. On principle, however, Mr. Sugg was quite right in striving to secure more comfortable surroundings for gas-cooking arrangements. In apparatus let out on hire, it was necessary that they should be as compact as possible; and if one ventilated the oven, the top burners were still open to the apartment. But if they were placed under the chimney jamb, it was a great improvement to putting them out in the open scullery. He trusted that some day builders of houses, when they found that gas cooking was playing so important a part in the domestic economy, would make a place for a cooker to be fixed instead of the ordinary coal-range. These cookers were now used, not only in summer, but also in winter, judging by the enormous increase in the consumption of gas between 11 and 2 o'clock.

Mr. John West was pleased that Mr. Sugg had not forgotten the pioneers in this movement. He had a great reverence for old names, especially that of Mr. Sharp. When he first went to the Northampton Gas-Works, some 43 years ago, gas-stoves were being made in the shops regularly and systematically by the Company, who did all the gas-fitting in the town. They made the stoves which had been designed by Mr. Sharp; so that he must have conceived the idea about fifty years ago. He had one of these antiquated things in his house at the present time; and he questioned if any of those now made produced much better results. They cost very little. The plates were made specially for the purpose, and they were put together very quickly by the workmen; so that they were some of the cheapest stoves which were made. The mystery to him was why this system of cooking by gas lay dormant so long. He thought it was probably because they did not know very much of each other at the time, which was ten or fifteen years before any gas association was formed. At that early time, Mr. Sharp enunciated the idea of ventilation; and one of the principles laid down was to try and get the gas-cookers put in the place of the ordinary grate, in order to get proper ventilation. This went on year after year; and gas cooking increased by leaps and bounds. Some years later, he remembered a paper on the subject being read by Mr. Magnus Ohren in London; and at that meeting he was surprised that so little was known by gas engineers about gas cooking. After leaving Northampton, he went to Maidstone, where he followed another pioneer, Mr. Somerville, and found a large number of cooking-stoves already introduced. A few years afterwards, he recollected Mr. Newbigging reading a paper on the relative quantity of gas consumed in various districts by day and night; and it was found that those places—Northampton and Maidstone—where

cooking by gas was introduced so early and so largely, were the two towns which were selling more gas in the daytime than any others in England. It was not necessary now to advocate the advantages of day consumption. The thing to press was proper ventilation. They often went to large houses, where a gas-man could tell immediately on entering it that the gas-cooker was not being properly ventilated. This caused annoyance. It upset the servants and everybody in the house; and they were sometimes thrown out of use on this account. He had always recommended managers, when letting out stoves, to see that they were properly fixed in suitable positions, and that the place was well ventilated. If they impressed the advantages of ventilation upon the people who were going to use them, as a rule their advice would be acted upon; but the matter must be properly looked after. It would not do for an engineer to stop when he had simply given instructions to his foreman. He must mix up with the community, and advise them, or see that they were properly advised, or else constant failures would be the result.

Mr. T. Bower (West Hartlepool) said that in the introduction of gas-stoves, it was absolutely necessary that great attention should be paid to ventilation; and nothing could be better than the method shown in fig. 4. He had recently introduced one of these ventilators into a room that was somewhat difficult to ventilate, about 20 ft. by 16 ft. by 13 ft. 6 in. high; and the ventilation was as near perfect as anything he had ever seen.

Mr. G. Helps (Bath) also considered that the most important part of the paper was that which bore on the necessity for ventilation. As to the quantity of heat required for cooking, it would be desirable if a table could be placed in the hands of every cook, stating the amount of heat required for cooking different articles of food. Taking into account the population of Bath, he thought there were a greater number of gas-cookers in use there than in any other town in the kingdom. He could almost go as far back in his reminiscences as Mr. West and Mr. Durkin. He thought it was about forty years ago when in their workshop his friend Mr. Warner made a gas cooking-stove which was in use for a great many years. At that time the Mayor of Bath was Mr. Falconer; and the stove being fixed, the Mayor and the members of the Corporation and reporters on the local papers were invited, and they cooked before them all kinds of joints, poultry, pastry, &c., very successfully. At that time, there was a firm of Davis and Sons in Bath, who went in for this particular manufacture; and he (Mr. Helps) thought that the stoves they made were as good as any on the market at present. They were certainly used very largely indeed. Messrs. Davis and Sons let them out on hire, which the Gas Company did not arrange for at that time. About 1000 were let out by Messrs. Davis and Sons before the Company began this class of business. There were now about 2000 on hire, besides those which were purchased by private consumers; and within the last nine or twelve months, the number of small cooking-stoves in connection with automatic gas-meters had been increasing daily. In fact, the demand was greater than they could meet; and there was never any occasion to advertise at all. With reference to ventilation, his own stove was fixed in the scullery at the back of the kitchen; and a flue was run to connect it with the kitchen flue. Unless the servant was in a great hurry, and turned the gas on too full, or the utensils were not kept clean, there certainly was never any smell in his house from the gas-stove. He had been cooking with gas for the last thirty or forty years; and he had used one of the Davis stoves to which he had already referred till quite recently.

Mr. T. S. Cleminshaw said he had had some experience of gas-cookers in the Australasian Colonies. The usual plan, when they fitted a new stove in a kitchen, was to fix it by the side of the ordinary range, with a 4-inch glazed pipe running into the chimney breast. The only trouble was over-ventilation. The stoves which had openings too large at the bottom, suffered from a chilling of the joint. In the winter, dry weather was very cold; but in the summer, it was stifling. The heat in Melbourne and New Zealand was often 105° to 110°; and as for ventilation itself, an apparatus like that depicted had been tried; but it was refused on account of the expense. The consumers thought it was quite enough to have to pay for the stove. Some of the companies charged cost price, and fixed the stove free; while others added as much as 50 per cent. profit, and charged for everything, in which case the stove business was very small. With regard to ventilation, there was a danger of the stove going out if the gas was turned down very low, especially if the burners were very many in number. Then there was the trouble of lighting-back. He recollected being called into a doctor's house, where the wife complained that she could not cook scones, much to her husband's dissatisfaction, and the smell was abominable. But on inquiring how she used the stove, he found she lit it through a hole in the bottom. Another question was that of the double and single oven stoves. The facility for toasting was better in the double oven than in the single; but against this, might be brought up the question that if the oven was simply made of sheet iron, it was found that the burner of a ¾-inch or 1-inch pipe underneath the iron would sometimes burn a hole right through, when, of course, the flame went into the top of the oven and spoiled anything inside. He had not had so long experience as Mr. West or Mr. Helps. But he well remembered, when his father was engaged as Superintendent of the Corporation works in Manchester (nearly forty years ago), that he had a boiling-burner, which was in constant use, and answered remarkably well. There was also the question of pressure, which had not been touched upon. Some engineers and stove makers advocated putting a regulator on the stove, in order to secure constant pressure; and so much had this question of constant pressure been insisted upon, that an Act of Parliament stipulated that between the hours of 12 and 2 o'clock, a pressure of 20-10ths should exist in Melbourne—the consumption during these two hours being the greatest of the twenty-four. On the other hand, he had known of works making 2 million cubic feet a year, where the pressure was 9-10ths in the daytime, which was quite sufficient for cooking, and 12-10ths at night, which was enough for lighting. With reference to dirt, in some cases the style of the stove had something to do with it—more especially those with a double oven and fittings fixed inside, instead of removable ones. He remembered one coming in which, at the bottom of the boiler, had three-quarters of an inch of fat, freely interspersed with cockroaches. With regard to the question of double or single oven stoves, he had in his own house a single-oven stove in which the whole of the Christmas dinner was cooked ready for dishing up. It was put in before they went to church, and was quite ready when they came home. He had seen it questioned in the "Journal of Gas Lighting" whether this could be done; but there was no doubt about it. As to the basting part, 2 lbs. of dripping were put over the turkey; and nothing could have been cooked better.

Mr. G. B. Irons (Gosport) said there were two ways in which gas was used for cooking—one known as the atmospheric burner and the other where the gas was used through a fine burner, reducing it almost to a blue flame. It would doubtless interest members greatly if Mr. Sugg could give his opinion as to which was the better way of using the gas. He should like to recall the fact that Mr. Sharp, in the early days of the British Association of Gas Managers, read a paper on "Gas Cooking;" and, in consequence of the paper, he (Mr. Irons) was directed to go to Southampton, and obtain further particulars on the subject. Unfortunately, Mr. Sharp was absent; but he was told he might see Mr. Sharp's young pupil, whereupon he was introduced to Mr. Durkin, who gave him every assistance. He would also like to remind the members that as long ago as the year 1851 certain makers of gas-cookers and heating-stoves had a special exhibition at the Polytechnic in Regent Street, London.

Mr. E. W. T. Richmond (Warrington) said that, though he heartily joined with those who looked back with admiration on the pioneers of gas cooking, and on the stoves they manufactured, he would remind them that modern stoves had the advantage of double cased and packed sides and tops, which very materially decreased the consumption of gas and the cost of cooking, and also the heat of the kitchen. They must all thank Mr. Sugg for his fresh treatment of an old theme—the advantages of cooking by gas. It was difficult to hit on any special method of attracting attention to it nowadays; but one could not do better than take advantage of every opportunity of driving home the fact that cooking by gas had advantages, in economy, cleanliness, and convenience, which coal-stoves in any shape or form never could offer.

There were now opportunities afforded of making the mass of the people familiar with these advantages, which had not heretofore existed. Many companies—perhaps chiefly in London and the South—were now lending cooking-stoves free in connection with the automatic meter system, thus bringing them into use by the working classes. He hoped by this means that the whole population of the country might be won over to this system. He was pleased to hear Mr. Durkin say that the day gas consumption paid. Some few critical people questioned whether the system of hiring-out stoves did answer; but no doubt the large majority would support what Mr. Durkin said. He fixed his own cooking-stove in the same way as Mr. Helps had described; and if the question of cost of ventilating the kitchen were such an obstacle to the use of stoves, he would suggest to the engineers present whether they should not slightly increase the rental of the stoves so as to cover the outlay involved in properly fixing. Many people would be quite ready to pay a few shillings per annum for the proper method of using the article, when they would not pay the several pounds which might be necessary to defray the first cost. Another difficulty sometimes suggested was that of the supply of hot water all over one's house. If some cheap method, both as to first cost and economy of working, could be hit on, which would provide a continuous hot water supply, it would be a certain means of winning over those who at present did not see their way to adopting gas cooking.

The PRESIDENT, calling on Mr. Sugg to reply, remarked that he thought the most important part of the paper was towards the end, where the author dealt with the question of ventilation.

Mr. SUGG, in reply, said that he had not mentioned Mr. Goddard's name, because Mr. Sharp, his brother, and Mr. Alfred King, were earlier; and he did not know that Mr. Goddard took any part in the inventing, but rather in pushing the use of gas-stoves. Mr. Durkin referred to the expense of ventilating kitchens. His paper dealt with small stoves as well as large ones; but with regard to the ventilation of small kitchens, he should have said that it was perfectly easy to accomplish this by diffusion, where there was a window open. If a piece of muslin or canvas was put in front of it, or even a curtain, it prevented a draught; and the diffusion between the internal and the external air would be sufficient. The internal air went out quicker than the external air came in; and constant motion resulted, whatever the state of the wind or the weather. But the ventilators he referred to were designed for larger places. M. Gouffé's stove was intended to be 8 feet long; and they could imagine the enormous amount of heat given off. If they had to do the same amount of work with gas, there was not anything like so much radiant heat. But carbonic acid was given off; and the steam rose naturally to the roof of the apartment. If it was taken off there by the ventilator shown, which would work in any weather, there must also be an inlet-ventilator, to admit the fresh air. In a place where perhaps £1000 was paid for cooking apparatus, the question of the cost of the ventilator would not materially affect the total outlay. Mr. West spoke of modern stoves as being cleaner than others, and Mr. Richmond of the double-cased stoves. But these must not be too highly rated as against the old ones, for this reason—the latter were made of tin and polished outside, and polished tin did not radiate heat as black iron did. The double stove, though it was enamelled inside to prevent radiation, still got hot through; and the heat would pass off to some extent. The only thing against the tin was that it did not last, and one could not keep the polished surface up; but there was very little radiation from them. As Mr. West said, the gas consumption by day was now approaching that at night, and in some places it was even more; and, of course, this must pay in the long run. Where there were no cooking-stoves, the mains were doing scarcely any work in the day; and if they increased the amount of work done without adding to the capital, it must be an advantage to the company. In the ordinary kitchens, where the stove was put under the opening of the chimney, a great deal of the heat went up the chimney, if it drew well. But, generally speaking, when a gas-oven was put into a house, it did not displace the iron kitchener, which was used to burn up the rubbish; so that if they fixed the stove in place of the kitchener, they would have to use a gas-jet to keep water hot, and a destructor to destroy the rubbish of various kinds which was now consumed in the kitchener. The cost of cooking at the Agricultural Hall for 1300 soldiers, three meals a day, was rather less than ¼d. a head. With regard to the question put by Mr. Irons, he was afraid it would touch rather upon a controversial subject—that of luminous and non-luminous flames. He was an advocate of luminous flames; but he would much prefer not to go into the matter, as he might be accused of being a fanatic on the subject.

NOTES ON THE CONSTRUCTION, AND EXPERIENCE IN THE WORKING, OF THE GADD AND MASON SPIRAL-GUIDED HOLDER AT THE CHESTER GAS-WORKS.

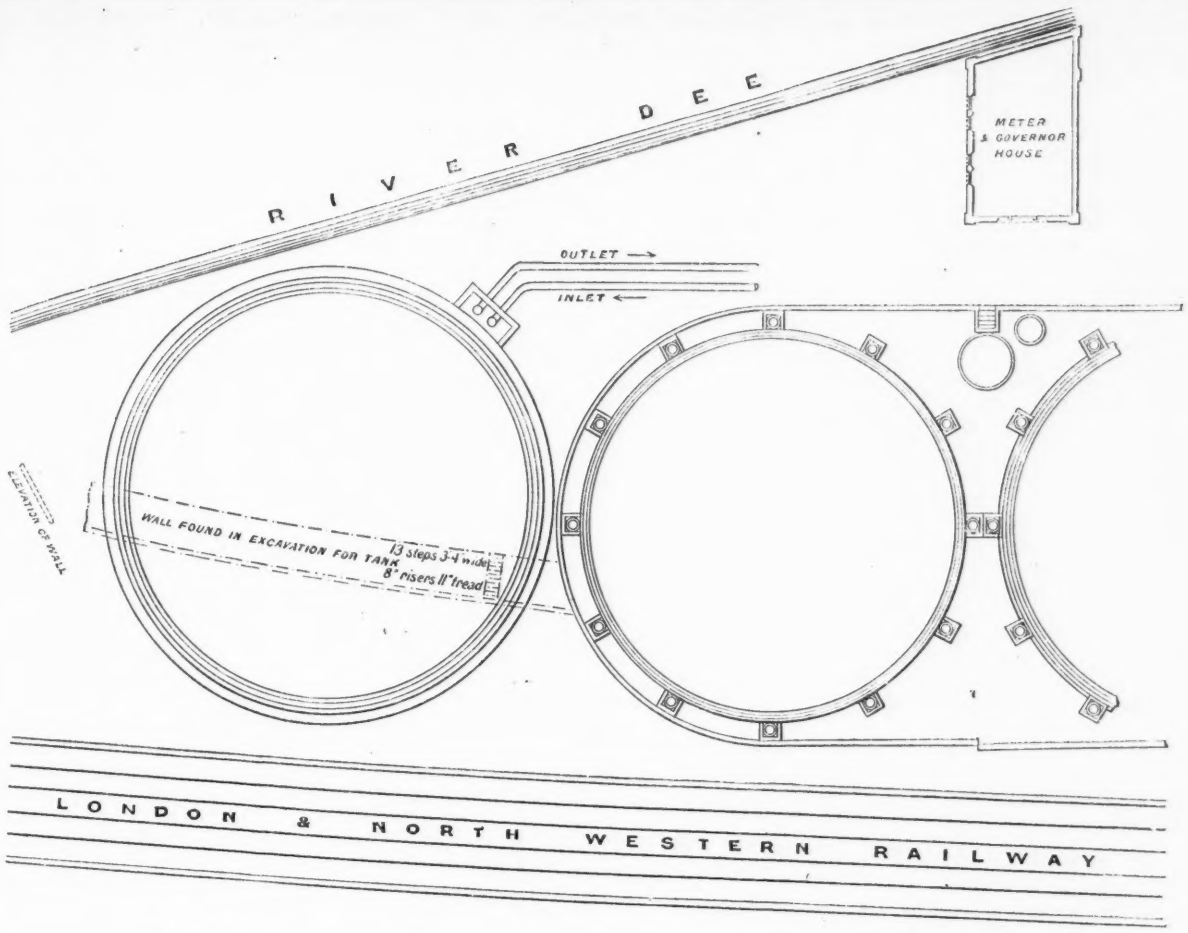
By ROBERT HUNTER, of Chester.

In laying before the members a few notes on the Gadd and Mason spiral-guided holder, it should in the first place be stated that this particular construction was adopted chiefly because it was found, under the circumstances, to be the least expensive. In considering the question of gas-holder capacity at Chester, various difficulties presented themselves. The space available for erecting another holder was awkwardly situated; being hemmed in on one side by the viaduct of the Holyhead branch of the London and North-Western Railway, and the other side sloping down rapidly to the River Dee. The ground consisted principally of silt and filled-up material; and it was therefore not particularly suitable for building a tank in, or for the foundations of columns.

During the progress of the excavation, an ancient river wall was found, about 70 feet from the present line of the river, built of large blocks of sandstone, at an angle of about 45°, starting from what was no doubt the original bed of the river. The wall had no foundation, and was built without mortar. A flight of steps led from the top of the wall to the bottom.

Before commencing the erection of the tank, it was intended to have built a river wall; but the work was hurried on in consequence of a very serious leakage having developed in one of the cups of the largest holder (a three-lift), necessitating a constant stream of water being kept running into the cup whenever it was clear of the water in the tank. As it was not convenient to empty this tank at that time to repair the damage, the full extent of which could not be ascertained, it was considered better to proceed with the erection of an additional holder before undertaking the repairs necessary. It was desirable to get a holder of as large a capacity as possible on the space available, and it was at the same time advisable to keep down the cost, so as not to increase the capital of the Company to any great extent. After very careful consideration, it was decided to erect a holder on the Gadd and Mason principle, which, after due inquiry, was found could be done at much less cost than a holder of the ordinary construction. The reports received of the working of those already in use being satisfactory, any doubts of their stability were removed, and the order was given. Partly because of the nature of the ground, and also with a view of getting a few feet extra diameter, it was decided to erect a steel tank, standing partly above ground, so that a very great depth of excavation would not be necessary, as it was feared the foundation of the railway viaduct would have been endangered, and moreover a large extra cost would have been entailed in keeping out the tidal water. Though the excavation was shallow, it was necessary to put in a puddle wall to keep back the tide, which at this point rises to within 2 feet of the surface level.

The tank stands 15 to 16 feet above ground level; and is 102 feet in diameter and 24 ft. 6 in. deep, with a flat bottom resting on a bed of concrete. The holder is in three lifts, each having 24 feet depth of side; the respective diameters being 100 feet, 97 ft. 6 in., and 95 feet, which gives a working capacity of about half a million cubic feet. The roof is dome-shaped, with a rise of 5 feet in the centre. It is not trussed, but rests on a timber framing when the holder is empty. The inlet and outlet pipes are 20 inches in diameter, placed side by side. The guide-rails are placed on the outside of the sheeting, and are secured thereto and to the vertical stiffeners of each lift by countersunk headed bolts. The inner and middle lifts have each twelve, and the outer lift sixteen, spiral guide-rails; but the author considers that the latter might with advantage have had eighteen or twenty.



THE POSITION OF THE GADD AND MASON HOLDER AT THE CHESTER GAS-WORKS.

The manner adopted for securing the guide-rails to the sheeting is not altogether satisfactory. The bolts are rather too far apart; and the strain, when a strong wind is blowing and the holder nearly up to its full height, is very great, and there may be liability of some of the bolts breaking, and thus weakening the whole. So far as the inner and middle lifts are concerned, there are no signs of any of these bolts giving way; but two or three of those securing the rails to the sheets of the outer lift have broken off short, whether in consequence of the strain being disproportionately distributed, or to defective bolts, cannot well be determined. There seems no possibility of replacing them without emptying the holder and blowing it up with air, to enable men to go inside on a raft and insert new bolts. The holes where the bolts have broken off are simply stopped up temporarily, to prevent leakage; and, of course, some extra care is exercised when the third lift is being filled, to see that everything is safe.

DIAGRAM Nº 1.

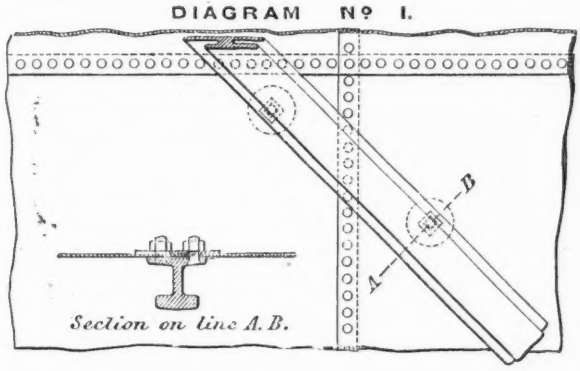
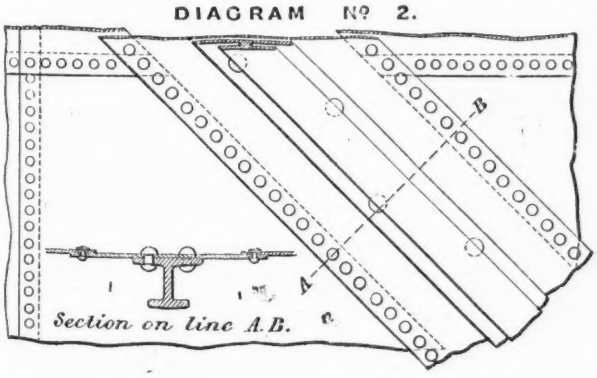


DIAGRAM Nº 2.



Another objectionable detail in this holder is that the guide-rails have not a level bearing throughout their length; and where they cross the joints of the sheeting, although the rivet-heads are flattened, there is a space between the rails and the sheeting in which the water lodges; and if the sheets behind the guide-rails cannot be painted or otherwise protected from rust, it is only a question of time when corrosion will take place and leakages develop. It is believed, however, that, with the patent pneumatic paint spray, this result can be effectually prevented.

Since the holder at Chester was erected, this latter objection has been remedied; the rails being now securely riveted to a spiral plate 10 or 12 inches wide, to which the gasholder sheets are also riveted. This not only strengthens the holder, but results in the guide-rails having a level bearing throughout their length; and the strain on the gasholder sheeting is distributed over a much larger area. It is to be regretted that these modes of construction had not been devised at the time the holder at Chester was erected. The author is so convinced of their superiority that, if called upon to erect another holder on this principle, he would insist upon spiral plates being applied.

The holder has been in almost constant use since April, 1894, and has worked smoothly and satisfactorily during the whole of this time. It so happened that during testing, and when blown up to its full height with air, it was exposed to a most severe gale, which it withstood without

showing any signs of weakness. On subsequent occasions during 1894 and the following year, it was also exposed to severe gales; but it continued to work steadily, and with less oscillation on the gauge than either of the other holders. During one of these storms, however, the wind was gusty and irregular, and, in consequence, one of the bottom guide-rollers, having rather too much play, got displaced; and the axle of the roller was somewhat bent. It was taken out, straightened, and replaced. In the course of the same storm, three of the countersunk headed bolts already referred to broke off short; the accident being discovered by the gas escaping from the bolt-holes. With these exceptions, no damage was, or has been, apparent.

During the severe frost in the early part of 1895, the water in the tank and cups was frozen to a depth of 12 or 14 inches. At this time there were at Chester no means of putting steam round the cups. But it so happened that no inconvenience was experienced, as, owing to the extraordinary demand for gas, the works were going at their fullest possible capacity in maintaining the supply; and for about a fortnight it was not necessary to use the holder. Before turning gas into it (to prevent accidents) a portable boiler was procured to steam the tank and lutes. Twelve or fourteen hours' continuous steaming was sufficient to loosen the ice from the tank-plates and gasholder sheeting. The ice was then broken, lifted out in lumps, and thrown into the river; so that, when the gas was turned on, no difficulty was experienced in working the holder. In this instance, the effects of frost were speedily overcome; but with other holders of the same type, for want of this precaution the ice got fast between the sheets and the inlet and outlet pipes. As a consequence, the holder, in rising on the admission of the gas, caused the pipes to get slightly twisted out of position; thus breaking the joints, and resulting in the pipes getting filled with water, and so stopping the flow of gas.

After the very excellent paper on columnless gasholders read before the members of this Institute last year, the author had some doubts as to the desirability of offering the present paper; but as the previous communication was confined more particularly to rope-guided holders, it is hoped that the foregoing particulars of the working of a spiral-guided holder may be acceptable. It is very desirable that those contemplating the erection of a holder on this principle should be in possession of all possible information, more especially with regard to any defects (however trifling) which may have shown themselves, so that they may be guarded against in any new holder of this particular construction.

It should be added that the appearance of these holders is not at all attractive. There is nothing graceful or beautiful about them, and they do not lend themselves to ornamentation; so that very little can be done to make them more sightly. But the proper proportioning of height to diameter should be observed, and the general design arranged as symmetrically as possible. In the author's opinion, a spiral-guided holder looks out of proportion, and has the appearance of insecurity, when the height exceeds one-half, or at most three-fifths, of the diameter. If, however, the appearance of insecurity can be tolerated, there is no reason why these holders should not be made higher in proportion.

Discussion.

Mr. Isaac Carr (Widnes) said that, as he had erected a gasholder on the Gadd and Mason principle of somewhat larger capacity than the one now described, but almost similar in its proportions, and as his experience differed from that of Mr. Hunter, he ought perhaps to say a word upon it. The main point in the paper was the accident, and how it arose. Mr. Hunter attributed it to insufficiency of carriers. Now his holder was larger than Mr. Hunter's; but the proportion of carriage and structure altogether was much about the same. It was erected in quite as exposed a position as the one at Chester; but he had had no such failure. In his opinion, this arose purely from the failure or partial failure of the steel tank. He did not know of any case where the tank was made of brick or concrete, where the holder had failed. But at Chester there was a steel tank 15 or 16 feet out of the ground; and an enormous lateral stress was thrown on the structure by a gale of wind, and one of the carriages failed. He thought the cause was that the steel tank was not sufficiently rigid—there being a certain amount of elasticity; and immediately the tank began to move, the stress would be unevenly divided. Instead of being distributed all over the carriages, it dragged them out of the straight; and the whole stress might be thrown on one or two, instead of on the whole. With Mr. Hunter's holder, with a pressure of 40 lbs. to the square foot, the actual stress would be about 88 tons, which distributed over his carriages would amount to 5½ tons per carriage. In his own case, he had one of the carriages of similar make tested up to 28 tons; and it did not break. The appliances terminated at 28 tons, so that he could not say how much more stress it would have borne. But it was put up with the rest; and it had been working for the last five years. They had had a difficulty with the Gadd and Mason holder in the overturning of the inlet-pipe through frost—a matter which was not anticipated by anyone. They had all had experience of thawing the cups; but no one would suppose that ice would form in the interior as it did after the frost of 1894. This was a matter of detail which only had to be understood in order that simple precautions might be taken to avoid their recurrence. He believed now, as he did when he advised his Committee to adopt this system, that it was one of the strongest forms of holders which could be constructed.

Mr. W. H. Y. Webber (London) said he could endorse every word which had fallen from Mr. Carr. The paper was a splendid encouragement to those who believed in the abolition of external guide-framing for gasholders. It did not touch in any particular a single point of the principle involved. It was a very valuable piece of technical literature. It told them exactly what were the details in regard to which Mr. Hunter was wiser now than he was when he decided to put up the Gadd and Mason holder; and this was exactly the kind of information which societies like this should be able to elicit. They had already heard that day of the difference between perfect theory and imperfect practice. But when one came to consider how radical was the departure made in the abolition of external guide-framing—a departure made entirely on the ground of theory, for there were absolutely no practical data of any kind to go upon—after the paper of last year, and after this paper, those who were interested in this question should be thankful, and take courage that so little could be said against it. The paper throughout brought out little points of detail of imperfection in the construction of a particular holder; and he quite agreed that any gas engineer who contemplated erecting such a holder could not possibly do better than go to Chester, look at Mr. Hunter's holder, and learn whether it would not be better to put an extra rivet here or there, or back up the guide-rail, and so on. But not one of these matters was an essential question of principle. He was pleased to hear the holder was so successful. He agreed with Mr. Carr that probably the displacement of the bottom guide-roller might be occasioned by the elasticity in the tank; or there might perhaps be too much play in the bottom roller. This reminded him of a point he made many years ago, which had been accentuated since, about the radical importance of having an absolutely trustworthy bottom roller, and equally trustworthy guide-path against which it worked. If one had a perfectly rigid roller-path, trustworthy attachments, and a strong roller—and, as Mr. Carr had shown, these rollers were very strong indeed—nothing could happen to the holder. What was done to the top was of comparatively secondary importance; but one must have perfect rigidity at the bottom. It did not require much argument to show that a sheet of a steel tank 15 or 16 feet out of the ground could not possibly be so rigid against the overturning strain of a gasholder guided from the bottom as if it were a brick or concrete tank in the ground. With regard to the twisting off or bending of the inlet-pipe, owing to the frost, this was an accident of which a great deal had been made, principally by gentlemen interested in other kinds of construction. But they saw now clearly enough how it arose. In 1894, they had a sort of test of the climatic conditions which were normal in other countries, and would have to be provided against in future. Mr. Hunter remarked that the appearance was not at all attractive; but was there ever a beautiful gasholder in the world? To his mind, one of the redeeming features of this construction was that when the holder was empty it was out of sight. The guide-framing was quite as hideous as the holder itself; and the best thing that could be done with a holder when one did not want it, was to let it disappear.

Mr. David Terrace (Middlesbrough) said he should

be glad if Mr. Hunter would tell them what the cost of the holder was.

Mr. Hunter, in reply, said the holder had not failed as Mr. Carr seemed to suggest. Three bolts gave way; but this did not imply a failure in working. They gave way not all in once place. If they had broken in the place where the roller had given way, there might be something in the suggestion that it was owing to the twisting or movement in this particular part; but he did not think it was anything of the kind. The holder at Chester was much more exposed than the one at Widnes, notwithstanding that the railway was on one side of it. The top of the tank was practically on a level with the rails. The wind blew with tremendous force, and when the holder was rising, and a strong wind was blowing, one could see the guides pulling at the bolts. These were placed 15 or 16 inches apart, which he thought was a little too far, as the sheets of the holder were very thin. By the new system, the guides were riveted rigidly on to a thicker plate, to which the sheets were afterwards riveted. There was thus no possibility of their giving way. The steel tank was made much stronger than usual. It would, he thought, take a great deal of force, when there were 5000 tons of water in the tank, in addition to the weight of the tank itself, fixed some 10 or 12 feet in the ground, to make it move even ¼ inch. He had purposely abstained from stating in his paper what the cost of the holder was; and he did not intend to do so now. Everyone who had to erect such a holder would be able to estimate what the cost of such a structure should be.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

It cannot be expected that during a week of such unprecedented National Rejoicing the record of business transactions in the Gas and Water Market should be extensive or interesting. But, despite all distraction, the settlement had to be got through; and, for fear of disarranging it, the Exchange was kept open even on Saturday. It is satisfactory to note that, although the volume of business was exceedingly light, yet the tendency did not fall at all weak, but rather the reverse—the strongest department being the American, while the South African was a fair second. Money was in good demand not only for the purposes of the Stock Exchange settlement, but to meet the normal requirements at the close of the half year. Movements in Gas have been very few, and for the most part unimportant; but the firmness which was the general characteristic of the week was shared by that department to its full extent. All change of quotation are in the upward direction. In Gaslights, the dealings in the "A" stock were sufficient to indicate strength, and indeed a disposition to rise, which a little more activity might have carried into effect—316 being marked more than once. Nothing was done in the secured issues. In South Metropolitans, not more than a couple of bargains were done; but the price was very nearly up to the top figure. Commercials were not touched. The Suburban and Provincial divisions were an absolute blank. The Continental group was the most animated; and Imperial was strong enough to make a substantial advance—changing hands on Saturday at 219. Among the rest, there was a disposition to buy Bombay; and of the South Americans, Belgrano and San Paulo each advanced in price. Water stocks were almost stagnant; but were favourably regarded—a few advances in quotations taking place.

The daily operations were: On Monday, Belgrano rose ¼; and San Paulo, ¼. Tuesday was Jubilee Day. On Wednesday, business was scarcely re-awakened; and Gas stocks did not move. In Water, Chelsea rose 2. On Thursday, there were some feeble flickerings of business; but quotations remained unchanged. Friday developed an approach to some revival; and prices generally were good. Imperial Continental advanced 1. Saturday's business was mostly in Bombay and Imperial; the latter advancing one point more. In Water, Chelsea preference rose 2.

ELECTRIC LIGHTING MEMORANDA.

The Diamond Jubilee Illuminations—The Part Played by Incandescent Electric Lights—Their Drawbacks—The Most Wonderful Sight of All.

It was to have been expected that the Diamond Jubilee illuminations would give a great impetus to the enterprise of electric lighting engineers who were not in the business on the occasion of the Jubilee of 1887. To some extent, this expectation was justified last week; for it must be acknowledged that those town districts, both Metropolitan and provincial, which are provided with public electricity supplies, presented a different appearance from that exhibited by localities destitute of the luxury. The illuminations everywhere, gas and electric, were magnificent; but when scrutinized in detail they cannot be said to have shown any radical departure from familiar methods and models. One of our leading technical contemporaries, the "Electrician," devotes a column of its current issue to a description of the part played by electric lights in the illuminations; and we have made use of the information thus given to correct or support, as the case might be, our own observations in this regard. The result is to show that only one distinct novelty, by way of addition to the resources of artists in decorative illumination, is to be recorded as special to the occasion. This is the new coloured spheres of celluloid, to enclose incandescent electric lamps, which were first seen, we understand, at the Paris illuminations on the recent occasion of the Czar's visit to that capital. These were largely used, both in London and in the provinces last week; and they were greatly admired by the populace. A considerable trade must have been done in these articles, which came upon the public as a pleasing surprise. The little balloons—for they are hardly more substantial than the flimsy india-rubber toy balloons so familiar to childhood—are about 4½ inches in diameter, made in halves, so as either to hang as spheres from a wire, or be used as hemispherical cases for incandescent electric lamps fixed against walls. Being either white or tinted, they lend themselves easily to any scheme of decorative illumination in which such lamps are employed. They will not stand much more knocking about than Chinese lanterns; and they must, of course, be extremely inflammable. Fortunately, no accident with them has been reported.

Coloured incandescent electric lamps were also largely used in wreaths and festoons upon the severe *façades* of public buildings of the classical style of architecture; and in some instances a pretty effect was produced by the use of naked incandescent lamps in plain bulbs with coloured reflectors. This device gives a brighter and more jewel-like effect than the tinted lamp bulbs, which render the light very dim. Our electrical contemporary remarks of the incandescent form of electric light, that these lamps "lend themselves to artistic decorative effect, and have the advantage over gas-jets in being artistic in themselves, even when not lit. Accordingly not a small part of the beauty of the daylight decorations has been produced by the dexterous intertwining of vari-coloured glass lamps with real or artificial flowers in festoons and wreaths, or by the arrangement of the bulbs in symbolic designs, surrounded by floral patterns of the same construction. These, whether by day or by night, served admirably their purpose of combining festal beauty and brilliancy, with the utmost possible guarantee against danger from fire or other accident." We are desirous of giving the electric lamps all the praise that is properly due to them in this connection, and therefore willingly repeat our contemporary's testimony for what it may be worth. We cannot, however, agree with this sweeping commendation of incandescent electric lamps on the two grounds of superior daylight decorative effect and freedom from the risk of fire.

In the first place, it must be obvious that bits of coloured glass must be of the same intrinsic attractiveness and artistic value, whether they constitute incandescent electric light bulbs, or the humble Vauxhall glass cups for gas or candles; and it is hardly worth while discussing what this amounts to by daylight. In the case of the electric light, the coloured lamps have the advantage that they can be attached to freely swinging festoons; but wherever this is done, the bulbs are pretty well hidden by the other decoration until they assert themselves after dusk. In the case of fixed illuminations—such as the outlining of the architectural features of buildings, and the like—the incandescent electric lamps have to compete on equal terms, as regards appearance, with gas and candle Vauxhall lamps; and it is certain that the former would have been much more largely used last week than they were, but for reasons of excessive cost and danger of fire.

With reference to the question of safety from fire, it is rather bold on the part of our contemporary to mention this point, seeing that the proposed outlining of St. Paul's Cathedral by incandescent electric lamps was given up on account of this same risk. The dome of St. Paul's was consequently illuminated by means of search lights directed upon the upper part of it from surrounding stations specially equipped with arc lamps for the purpose; and a very fine effect was thereby produced. In fact, the use of incandescent electric lighting for the numerous wooden stands and other structures, whether permanent or temporary, illuminated in this way for the Jubilee celebrations, was a source of great anxiety for all concerned. The lamps themselves might be safe enough—though even these are not always quite innocuous sources of heat, when buried in flimsy paper parched up by the rays of an unclouded Midsummer sun—but the running of live wires along wooden scantlings, perhaps littered with sawdust and light shavings, and subject to the hurried driving of nails, is not a particularly safe proceeding. "Short circuit" is a phrase of dire meaning in these conditions. As a matter of fact, there were several small fires, in St. James's Street and other places, due to this cause. However, "all's well that ends well," in Jubilee illuminations as in other human affairs. Many wonderful things were shown to the world last week; but perhaps the most wonderful show of all was that of the preparations on an unprecedented scale for the witnessing of many spectacles by the greatest gathering of people ever brought together, and all done without any serious "accident."

LABOUR IN THE VICTORIAN AGE.

Among the many reflections to which the culminated glory of the Victorian Age has given rise, there is none that can be indulged in more unreservedly than that of the actual improved condition of the labouring class of the community. It is a fine thing to realize, as was never done before, all those grand visions of world-wide empire that have dazzled the people of this astonishing realm during the past week. There has been something in the happy completion of the Sixty Years' Reign well worth flashing our electric lights, blazing our gas illuminations, and flaring our fireworks and bonfires about; but if the hackneyed complaint of the Socialists had been well founded, and the operation of our Imperial institutions had been to "make the rich richer, and the poor poorer," there would have been a deep shadow over our rejoicings. There have been empires before the Victorian; but it is safe to aver that never under any one of them was the lot of the people who have to work for their daily bread so happy as it actually is here and now. It is to be supposed that when the Socialists have tired, with the rest of us, of pageants and feastings, illuminations and decorations, they will return to their old business of lamenting over the circumstances of the poor and reviling the greed of the rich. They will continue to take as one-sided a view as ever of the universe, and persist in blaming civilization as being the cause of every industrial evil under the sun. Those who prefer to look at the state of the labouring population of these kingdoms in the light of facts rather than by the glamour of misty theories, will, however, experience no difficulty in agreeing with a recent writer in "The Times" that "no class in the community has more reason to be satisfied with the results of the last sixty years than the working men."

Let us therefore turn for a moment from discussions of those imagined boons which the professional agitator would have us believe are essential to the well-being of the working classes. Let us cease for the time being to ponder how much better off the labouring man will be when the land and all the means of production and transport are nationalized; when every man has his one vote and no more; when members of Parliament are paid, and all election expenses are thrown upon the rates or defrayed out of the surplus profits of municipalized gas undertakings—and consider what the past sixty years have brought to the poor Englishman. Into this period, as "The Times" writer points out, have been crowded a series of economic and legislative changes, on the whole making for the comfort of the working classes. "They have got their 'six points,' or something better. It was the utmost demand of their best friends at the beginning of the present reign that they should be free to work out, by combination or otherwise, in their own way, their salvation; that their societies should be legalized; and that the criminal law should not be used to increase the power of capital—in a word, that they should suffer from no disabilities. They find themselves in 1897 in the position of a privileged or favoured class, fenced about with special legislation, and possessed of some rights denied to others. And this period has also been for them one of unexampled material prosperity. Their wages have risen, while the prices of food and most articles of consumption have fallen. The State educates their children gratis. The State makes the acquisition of allotments easy for them. The Municipalities give them recreation grounds and free libraries. If they save, the State finds them an investment without risk, and pays them interest at a rate which they would not always obtain elsewhere. One of the latest acts of the House of Commons was to approve a measure which, surpassing the dreams of the labour leaders of sixty years ago, binds the employer to compensate an injured workman, even if the former is blameless."

It is well to remember that these ameliorations were not in the main extorted by labour leaders from a reluctant oligarchy, nor were they the work of "popular," to say nothing of paid, politicians. The Factory Acts, which have placed a large section of the British operative population in a position envied by the same class in other countries, and the Truck Acts, were freely granted from above with no idea of propitiating a class of voters. "What brighter jewel in a Sovereign's crown, what nobler record of a reign, than the fact that it witnessed the childrens' emancipation, that it released from toil in tender years the sons and daughters of the poor?" Sixty years ago, there was prevalent a fear of combinations of working people which, in the circumstances of the time, was not without excuse. Society did not talk so much about Anarchists then as it has done of late; but it knew the thing represented by the name better, and feared it more. Trade Unions were illegal combinations; and if the members of such societies were not actually indictable—which is doubtful—the Union was regarded as outside the pale of the law. Its funds might be, and often were, misappropriated with impunity. At the present time, the law of such matters is so relaxed that Trade Unions enjoy the maximum of power with the minimum of responsibility.

Sixty years ago, employers and employed were not equal before the law. The master who violated a contract of service was liable much in the same way as if he broke any other contract; but a runaway workman might be arrested on a warrant and punished by imprisonment. "Of the labour laws which pressed hardly on the working men in their struggles for higher wages and shorter hours, little remains; for one cannot view as exceptional the restrictions still maintained on conduct directly injurious to others. . . . There was ground for complaining that the workman who was injured did not, under the common law, get the redress which was open to others; the doctrine of common employment was a fiction, and not a useful one. But this injustice was partly rectified by the Employers' Liability Act, 1880; and if, as is probable, the Government measure for compensating injured workmen passes, the workman will be in the happy position of being insured without paying any premium." He has received many other benefits. For example, though he run into debt, his wages are safe, which is more than can be said of the salaries of his superiors. His tools are exempt from seizure; his wages stand among the list of preferred debts in bankruptcy or winding up. There is no "tariff" to upset the ordinary course of trade, and to heighten, as it does in the United States, the natural power of capital to initiate and determine employment. Nor are the common necessaries of life taxed to double their value, as is the case on the Continent of Europe. If the British workman is not satisfied with all that England has done for him, he is at perfect liberty to emigrate; nor does he sacrifice his citizenship in the act, like the workman of any other nationality and tongue.

The writer remarks that if someone who had emigrated from our shores sixty years ago returned to-day, he would scarcely recognize in the ordinary working men the sons or grandsons of the working men whom he knew. "He would note that their dress and that of their families was much improved; they wear better clothes than their masters wore in 1837. They eat and drink better food and drink than was then within their reach; and, with the price of wheat which has ruled in recent years, they know nothing of the sharp pressure of want, the periodic returns of semi-starvation which then visited large masses of men. Such an observer would find that the working man's house was more commodious and better furnished, and, if his tastes kept him from the public-house, had its little store of luxuries and ornaments. Model dwellings are erected for him. Tramways and workmen's trains convey him to his work; and the bicycle promises to enable him to live where rent is low, and where there is no overcrowding. If he is ill, hospitals which he does little to support receive him. His hours of work are not so exhaustingly long as to stimulate him to coarse debauchery, and make mental cultivation an impossibility. Should he or his sons be studious, there are free libraries; institutions which, at convenient hours, give him sound instruction; and plenty of people disposed to applaud his efforts to better his lot or enlarge his intelligence." All this, of course, is the veriest commonplace; but the occasion is one for the notification and evaluation of the obvious.

There is much in the actual condition of the English workman that the observer whom we have been quoting does not mention. During the present reign, he has not only gained his political liberty and his social emancipation from the last remnants of industrial servitude; he has also attained responsibility, and exercises a part in government. The Co-operative Society and the Trade Union have proved schools of statesmanship of which the nation has, on the whole, no cause to be ashamed. The workman director, the Trade Union member of Parliament, are products of the reign of the first significance. They symbolize the first success achieved by working men in the way of distinguishing themselves without previously leaving their order; and the importance of this consideration can hardly be exaggerated. As "The Times" writer very truly remarks: "In England there were never castes. A strong and industrious man might always push his way out of the ranks of the employed into those of the wealthy or well-to-do." But the writer overlooks the point of the whole matter, from the sociological view, which is that nowadays men can be distinguished and eminent without quitting the ranks to which they belong. Yet see what an enormous difference this makes. How much better it is for the community as a whole that the standard of individual success and distinction should no longer be the money-bag, but the man! Which is the more distinguished individual—he who, as the phrase goes, has "risen from the ranks," or he who elevates the ranks by remaining in his place and exhibiting to his fellows a pattern of integrity, loyalty, and public spirit? It is all the difference between millionaires of the stamp of the late Mr. Barnato and men like Mr. Abraham, Mr. Burt, and many another who might be named. There can never be a large number of millionaires, whether self-made or otherwise; but there is plenty of room for statesmanlike working men.

Of course, there is another side to the picture. The old system of apprenticeship is in decay; and we have not yet found a substitute. The old friendly and direct personal relations once common between employer and employed are not so practicable when the latter are privates in an organized army. The transformation of so many who sixty years ago would have been agricultural labourers into artizans and workmen, for the most part living in towns, though the change has been accompanied by a rise in the average wage, has an evil side. In our cities, partly owing to this movement, there is a residuum familiar with want, shiftless, thriftless, and not amenable to any rapid improvement. For the decay of apprenticeship the Trade Unions and the Board Schools are largely responsible. Not only is the migration of labour from the country into the towns a sign of the times; but the misdirection of youthful energies from the work-

shop to the counting-house and the class-room are equally striking indications of the sweeping character of the changes that sixty years have brought into the circumstances and aspirations of the working classes. What is to be the outcome of these new movements time alone can show. The old labour agitators were rough men, ignorant of school learning. Yet those of them who managed to "keep up with the procession" for a number of years, like the late Mr. Charles Bradlaugh, were no Socialists, because they knew from personal experience that there was no foundation for the data of Socialism. The successors of these men will be the forced product of the national school system—demagogues destitute of experience of real hard work, with heads full of undigested theories about the mutual relations of the State and the Individual which they will be anxious to put into action at the public charge. Well is it that one cannot see into the future. With regard to the future of the working classes of this country, it is possible to agree with "The Times" writer that "fortunate will they be if the sixty years to come are as rarely broken by disasters to the working people, and as full of blessings to them, as those which now end."

THE RECOVERY OF BENZOL FROM COKE-OVEN GASES.

THE extension of coal distillation and of benzol recovery in Germany threatens to rapidly extinguish the German demand for benzol from this country. Such indeed is the substance of the views of Dr. Krämer, to which attention was called in the "JOURNAL" for May 11 (p. 1058). An abstract of a paper on benzol as an illuminant by the learned doctor was given in last week's "JOURNAL" (p. 1421); and our readers are thus aware of the importance he attaches to the recovery of benzol from coke-oven gases. A paper bearing more directly on this subject has been communicated by Dr. C. Heinzerling to the "Chemischen Rundschau;" and to it chiefly we are indebted for the following particulars on benzol recovery. It may not, however, be out of place here to observe that "benzol" is the term applied to the commercial products containing upwards of 75 per cent. of benzene, and 25 per cent. or more of toluene, xylene, and other hydrocarbons and impurities. The pure hydrocarbon represented by the formula C_6H_6 is known as "benzene." Commercially pure benzene is made from coal tar, and consists almost wholly of the pure hydrocarbon. In trade it is known as "chemically pure benzene," and not as benzol. The German word "benzol" has a wider application, and is often used to signify pure coal-tar benzene.

Benzols were first obtained on a considerable scale by Mansfield about the year 1850; and they were then, and for some years subsequently, only used as solvents of caoutchouc, and for the removal of grease. The great impulse to the benzol industry came with the discovery of the dye-products obtainable from aniline, which had been first obtained from benzene by Hofmann. Kekule's theory of the tetravalency of carbon, and of the constitution of benzene, was propounded about thirty years since; and from that time benzene took first rank among organic compounds, on account of its theoretical as well as industrial importance. The aniline colour industry arose in England and France; but it attained its full development in Germany. Benzol—which was the starting point for all the earlier-known coal-tar colours—was in the sixties obtainable in considerable quantity only from England. The sole source of benzol at that time was coal-tar; and in England only had the gas industry and the make of coal-tar reached considerable proportions. Even at the close of the seventies scarcely one-eighth of the benzol used in Germany was produced in that country. At the present time the German production amounts to at least three-eighths of the national requirements; and the proportion is increasing very rapidly. The increase is not due to a great advance in the make of illuminating gas; for in this item Germany remains far behind England. In 1895, 11,937 million tons of coal were used for gas making in Great Britain; while only 1516 millions were used in Germany.

The high heats from the regenerative settings which now prevail in gas-works have somewhat reduced the proportion of benzol in the coal tar; and not more than 1 per cent. of the mixture of benzene, toluene, &c., can now be expected from tar. Deville and Bunte showed that 1000 cubic feet of coal gas contained no less than about 43 oz. (avoirdupois) of benzol; and when in 1860-70 the supply of benzol from coal tar became inadequate, attempts were made to obtain the benzol from the gas. The removal of the benzol greatly deteriorated the lighting value of coal gas; and hence the attempts were abandoned. But the processes then tried were subsequently applied to the extraction of benzol from coke-oven gases. The production of benzol as an independent industry has notoriously failed whenever it has been attempted; and the reason is not far to seek—the price of benzol fluctuates too severely. In one year, the price of 90 per cent. benzol fell from 16*s.* to 1*s.* 6*d.* per gallon! A curious result of the unsettled state of the benzol market has been that incessant endeavours have been made to obtain the majority of coal-tar colours from naphthalene, instead of aniline, and thus make the colour manufacturer independent of benzol. The naphthalene colour industry has enormously developed; and one of its latest triumphs is to produce indigo, which has hitherto been obtained artificially from toluene.

About 40 per cent. of the oven coke now made in Germany is produced in close ovens fitted with tar and liquor condensing apparatus. The gas is drawn by exhausters from the ascension pipes through a tar extractor to a tubular water-condenser; the ammonia remaining in the gas when it leaves the condenser being removed by scrubbing. Generally the gas is then used without further treatment for the firing of the ovens. But about ten years ago, an attempt was made to extract the benzol from the gas. Coke-oven gas contains barely half as much benzol as does ordinary coal gas. Several processes for the extraction of the benzol from the gas have been patented in England. The one now commonly adopted in Germany consists in treating the gas in large wash-towers with the middle or heavy "dead" coal-tar oils, and, when the latter are saturated, removing the benzol from them by distillation. The oils are returned to the wash-tower in order that they may act on more gas; and theoretically they should serve for use for an indefinite period. But according to Dr. Heinzerling they soon become thickened by particles of coal dust and tar; and they are thus rendered unsuitable for repeated use. Nevertheless nearly 5000 tons of benzol per year were extracted in this way from coke-oven gases in Germany during the two or three years preceding last year. This amount was about three times that obtained from coal tar during the same period; and the price of 90 per cent. benzol fell in consequence to 1*s.* per gallon. The fall in price temporarily checked the increase of benzol recovery at the coke works; but towards the end of last year the price of "nineties" rose to as much as 4*s.* 9*d.* per gallon, and this again stimulated production.

A new process for the recovery of benzol from the gases has recently been patented by Dr. Heinzerling. The gas on leaving the ammonia scrubbers is subjected to 3 to 3½ atmospheres pressure, and then cooled by water condensers to 50° to 54° Fahr. By passing through condensers in which the cooling medium is the return current of expanded gas, it is further cooled to − 22° to − 40° Fahr. The cooled compressed gas is then permitted to expand; and the effect of expansion is a reduction of temperature to nearly − 112° Fahr. At − 94° Fahr., the tension of benzene vapour is practically *nil;* so the whole of the benzene is at the above temperature separated from the gas. The expanded gas then serves, as already stated, to cool fresh gas. The principle of cooling here adopted is that applied by Professor Lindé to the liquefaction of air. The amount of gas made in the ovens more than suffices for firing the ovens and supplying a gas-engine to drive the compressing plant; so, in practice, the gas is allowed to expand into a large chamber, and is not caused to do work in a cylinder. A trial installation showed that 80 Otto ovens, working off about 220 tons of coal per 24 hours, yielded 2,120,000 cubic feet of gas, from which an expenditure of 240-horse power sufficed for the extraction of about 300 gallons of benzol. This benzol had the following composition, expressed in percentages by weight: Benzene, 67·03; toluene, 15·61; xylene, 2·18; higher homologues, 6·41; naphthalene, 3·79; thiophene, 0·71; minor constituents, 2·77. On the other hand, the benzol obtained by washing the gas with oil contained: Benzene, 85·1; toluene, 11·63; xylene, 1·4; other constituents (by difference), 1·87. The former benzol contains less, but the latter considerably more, benzene than does the English 90 per cent. benzol. It is desirable before subjecting gas to Heinzerling's cooling process to dehydrate it by means of sulphuric acid or calcium chloride. The removal of the aqueous vapour prevents the formation of ice in the coolers, lessens the work of compression, and facilitates the recovery of small quantities of ammonia. It is also desirable to filter the gas so that coal dust does not enter the compressor.

Only a small proportion of the coke ovens of Germany are fitted with benzol extraction plant; but the number so fitted is rapidly increasing, and the supply of benzol should in future amply suffice, not only for the colour industry, but also for enriching coal gas for illuminating purposes. Indeed, if the coke-oven production should, in the future, increase as it now threatens to do, there will be a large surplus over and above the requirements for these two purposes. It is, therefore, improbable that coal-tar benzol will ever again fetch more than very moderate prices.

The methods of estimating benzene in gas concern the gas engineer as much as the coke manufacturer. Bunsen's method consisted in passing the dried gas slowly through absolute alcohol, which absorbed both benzene and other heavy hydrocarbons. The hydrocarbons were thrown out of solution by the addition of a concentrated solution of salt, and were measured. The results were too high. Deville separated the aromatic hydrocarbons (benzene, toluene, &c.) by the application of cold. The dried gas was first cooled in a narrow worm immersed in a mixture of ice and salt, and then in two worms cooled to −94° Fahr. by means of methyl chloride. At this temperature the tension of benzene is *nil;* and, therefore, the whole of it is thrown down from the gas. The amount is ascertained by weighing the tubes. The benzene can be purified by fractionation if necessary. Dr. Heinzerling found liquefied carbonic acid a good substitute for the methyl chloride. The benzene in gas may be more simply, but less accurately, determined by passing the dried gas through several washing-bottles containing cumene, and kept cool by a freezing mixture. The volatile hydrocarbons absorbed are distilled off from the cumene at about 290° Fahr., and the distillate is then fractionated, and the benzene obtained weighed.

OBITUARY.

The death last Friday night, after a long and painful illness, of Mrs. OLIPHANT, the popular authoress, calls for mention in these columns from the fact that she was the writer of the interesting article in "Blackwood," entitled "'Tis Sixty Years Since," which was noticed in the "JOURNAL" for the 15th inst. Her literary work began when she was eighteen; and it has closed at sixty-nine.

Mr. JOHN GRANT MORRIS, who was some twenty years ago a prominent personage in Liverpool, died at his London residence last Wednesday. Mr. Morris rose from exceedingly humble circumstances into a position of affluence. He began life in a lowly position in the coal trade; but before long he reached the status of master, and eventually became possessor of extensive collieries. In 1846, he was elected a member of the City Council; and twenty years later, he was awarded the highest distinction of the city—the Mayoralty. Mr. Morris retired from municipal work in 1874; but he continued to figure in public estimation as a Director of the Liverpool United Gaslight Company. He served on the Board for no less a period than 37 years—from 1855 until 1892—and was Chairman during 1863-4. One of the most important acts of Mr. Morris's life was (says a Liverpool contemporary) probably quite unknown to the majority of the citizens even in his day. Rather more than twenty years ago, he conceived that it would be greatly to the advantage of the Council and of the public generally to become the possessors of the undertaking of the Gas Company. He held many conferences on the subject with the late Mr. Edward Whitley, who was then the leader of the Conservative party in Liverpool; and the question was debated in all its phases. Eventually the purchase of the Company was informally arranged on terms, it was believed, favourable to the Corporation. But just when the matter was ripe for submission to the Council, the electric lighting scare occurred; and the project was reluctantly abandoned in the belief then prevailing that the purchase of any gas concern would be quite out of harmony with the views of the inhabitants.

PERSONAL.

Mr. HENRY GREEN, Engineer to the Preston Gas Company, is one of the Jubilee Justices appointed for Lancashire boroughs; another being Mr. W. J. CROSSLEY, of Manchester.

Mr. B. W. SMITH, the Manager of the Smethwick Gas-Works, was last Friday the recipient of a testimonial from the workmen. The occasion of so much public rejoicing was regarded by them as a fitting opportunity for expressing their esteem for their Manager, and the hope that his connection with them would not soon be severed; and they asked him to accept a meerschaum pipe and a walking-stick, with their best wishes that he might be long spared to enjoy both. Mr. Smith, in acknowledging the gifts, said that if, in the discharge of his duties to his employers, he had made himself agreeable to the men, he was proud, as it had always been his ambition to do what was right and just between them.

In the list of honours conferred by Her Majesty on the occasion of her Diamond Jubilee, we notice that Mr. A. R. BINNIE, M.Inst.C.E., and Mr. W. CROOKES, F.R.S., are to be Knights; and that Mr. H. C. BURDETT, Dr. E. FRANKLAND, F.R.S., and Dr. R. THORNE-THORNE, C.B., are to be Knights Commanders of the Bath. All these gentlemen are known by repute to our readers. Mr. Binnie is the Chief Engineer to the London County Council, and was previously for about fifteen years Water Engineer to the Bradford Corporation. Professor Crookes has a world-wide reputation as a chemist and investigator. He first gave the scientific world the idea of radiant matter. He has held office as President of the Chemical Society; and he is now Vice-President of the Royal Society. He is one of the Water Examiners appointed by the London Water Companies to make daily tests of their supplies. Mr. Burdett, who is best known to our readers from his annual volume of "Official Intelligence," published in his capacity of Secretary of the Share and Loan Department of the Stock Exchange, has a wide reputation as an authority on hospitals; and he is one of the Committee of the Prince of Wales's Hospital Fund. Dr. Frankland's valuable work in connection with the gas industry does not require to be mentioned here; it is recorded in our pages. He was for some time Professor of Chemistry at St. Bartholomew's Hospital, and has held other important professorships. He has been President of the Chemical Society; and he was the first President of the Institute of Chemistry. He is an acknowledged authority on questions bearing upon the chemistry and bacteriology of water; and his monthly reports to the Registrar-General on the quality of the London Water Supply were for many years regularly given in the "JOURNAL." Dr. Thorne-Thorne is Medical Officer to the Local Government Board; and his name is associated with some highly important investigations. A gentleman whose name was accidentally omitted from the list of new Knights as first published should be mentioned here from his connection with the New River Company. Mr. H. HARBEN is a Director of the Prudential Assurance Company; and when a few years ago they purchased an original share in the New River Company, entitling the possessors to send a representative to the Board, Mr. Harben was selected.

NOTES.

Light Coal-Tar Oil as a Germicide.

Dr. Tichborne, of Dublin, in a paper on germs and sewer gas, discusses the best methods of destroying the disease germs that are supposed to be carried by the latter. Upon the question of how these germs rise from their place of generation in the sewers of towns to be carried into the air of adjoining dwellings, Dr. Tichborne confesses himself more than a little puzzled. He thinks, however, that they are possibly carried by a condensed vapour exactly represented by ordinary dew. He believes that, at certain hours of the night, the comparatively warm air of the sewers is chilled, and a germ-laden fog formed, by the entry of cold night air from the open traps. He has found from actual experiment that the temperature of the sewer water as it flows from the large sewers, or the temperature of the gas in the street mains, is generally 2° or 3° above that of the night air. Even a sudden rise of the barometer will just determine the deposition of the liquid portions of the gas in the mains, and in the same manner will determine, even more energetically, a dew-line in the sewers. Dr. Tichborne suggests the use in town sewers of a germicide formed upon a basis of naphthalene, and of such a specific gravity that it will float upon the surface of the sewage. The cheapest form of such a germicide is to be found in the "light coal-tar oil" which first comes over in the distillation of tar. This mixture would float on the surface of sewage, locking in the germs; while it would throw down phenol and naphthalene by simple solution.

Cleaning Ice-Covered Sand Filters.

A recent number of the "Journal für Gasbeleuchtung" contained an illustrated description of a device used for cleaning the uncovered sand filters at the Hamburg Water-Works when the surface of the water is frozen. Until last winter, this was done by hand dredging from a flat boat drawn from side to side after the ice had been broken up. The removal of the ice was so expensive, however, that last winter an arrangement was utilized which allows the clogged surface layer to be scraped off without removing the ice, except a strip along the two sides of the filter. The appliance is simply an open-mouthed pouch suspended by a float, which is dragged from side to side of the filter-bed by a cable, and thus cleans a strip about 8 feet wide. The float has a flat elliptical cross section as a surface of contact with the ice; and the hangers of the dredging pouch have a play of 15° on either side of the vertical—allowing the pouch freedom to meet such slight inequalities as may be found in the surface of a sand filter, and also to permit of its being raised and emptied when it reaches the side of the filter. In operating this device, a cable is stretched across the filter below the ice, and attached on each side to a windlass mounted on trucks which run along the filter-bank on rails. When the surface layer of the filter becomes clogged, a strip of ice is cut away along the two sides of the filter, and the trucks wheeled down to one end. The dredging bag and float are then pulled across the filter under the ice, by winding up the cable on one of the windlasses. When the transit of the filter has been made, the pouch is raised and emptied. The trucks are then rolled forward slightly, and the pouch started back on a strip of surface adjacent to that first cleaned. The working of the arrangement is said to be very efficient, and much more economical than the old system of clearing away the ice.

Deception in Colour Vision.

Some of the tricks played by different coloured lights upon the human retina were exposed by Mr. Shelford Bidwell at the last Royal Society *conversazione*. They carried further the familiar phenomenon of retinal fatigue, which causes those who have gazed steadfastly at any brightly lighted and coloured object, to see afterwards a more or less persistent "ghost" image of the object in its complementary colour. Mr. Bidwell has now succeeded in so reducing the period required for the preliminary stare that the sensation is practically eliminated from the observer's consciousness, and the object looked at is seen not in its own but in the complementary colours. For this, all that is required by way of apparatus is a disc divided in the first place into white and black halves, from which a section of about 60° opening is cut out, so as to remove equal portions of the black and white surfaces. This disc is caused to revolve at a speed of six or eight revolutions per second before the coloured object, while its front surface is strongly illuminated either by diffused daylight or by a powerful lamp—such as an incandescent gas-light. In the latter case, the direct vision of the light should be prevented by placing a tin reflector in front of it. Under these conditions, a red card placed behind the disc appears green, a green card pink, a blue one yellow; while a black patch painted on white ground appears whiter than the ground itself.

Stripping a Reservoir Site.

Some particulars were given a short time ago in the "Engineer" in regard to the method adopted in stripping a reservoir site in connection with the Boston (Mass.) Water-Works; considerable care and a great deal of money being expended in thoroughly clearing the land which will be submerged, in order that nothing may be left to give rise to risk of pollution, or to impart an unpleasant taste to the water. In the reservoir in question, the minimum depth of water will be 8 feet. Shallow

bays are either excavated to the full depth, or filled up with the excavated material to a height of 2 feet or 3 feet above the high-water line; the bank being then sloped to a grade of 3 to 1, and covered with about 2 feet of gravel. The work consists in general of stripping off all the surface soil, stumps, roots, and other organic matter below the contour of the 8-feet water-line. The quantity to be removed is about 4 million cubic yards. Trees are cut down, and the stumps are pulled by stump-pullers, or blown out by dynamite if very large. The removal of the soil is done by hand digging; the material being hauled away by waggons and teams, or by narrow-gauge dump cars. These cars are hauled up from the excavations by cables and hoisting-engines, and then taken to the dumping-point by horses or locomotives. The muck and swamps, if shallow, are excavated entirely, right down to the underlying stratum of clean material. Nearly half of the work is done by teams; and the work progresses at the rate of about 300,000 to 325,000 cubic yards per month. The loam averages 12 inches thick on the upland; and from 1 foot to 10 feet thick on the meadows or bottom land. The appearance of the surface after the stripping has been done is very singular; being a bare, hard land.

The Mechanical Equivalent of Heat.

Professor Osborne Reynolds and Mr. W. H. Moorby have communicated to the Royal Society the result of a re-determination of the mechanical equivalent of heat which they have had in hand since 1890. This research was undertaken in consequence of the occurrence of circumstances which afforded an opportunity such as might not again occur. This consisted in the facilities offered by the appliances which formed the original equipment of the Whitworth Engineering Laboratory, in 1888; the more essential of these being an engine of 100-horse power, working one of Professor Reynolds's hydraulic brakes. This brake maintains any constant moment of resistance on the engine shaft, independent of the speed; all the work done being converted into heat, which appears in the rise of temperature of a steady stream of water flowing through the brake, the magnitude of which stream is independent of the load on the brake or the speed of the engine, and is under independent control. The research was further facilitated by the existence of the Manchester town's water, of a degree of purity expressed by 3 grains of salts to the gallon, conveniently distributed in the laboratory; as well as auxiliary power, both steam and water. The research was commenced unconsciously, with some experiments directed to the verification of the mechanical balance of the brake, which lasted over two years. Then it occurred to Professor Reynolds that, by the same method, great facilities were presented for the independent determination of the mechanical equivalent, if it could be arranged that water should enter the brake at the temperature of melting ice, and leave it at that of water boiling under the standard pressure. In July, 1894, Mr. Moorby undertook to devote himself to the research, which continued during two years. Eventually, after making all corrections, the mean corrected value of the specific heat of water between freezing and boiling points, as measured in mechanical units at Manchester, was found to be 776·94.

Cusack's Photometer.

Some observations on the photometric effect of change of temperature on phosphorescent substances have been communicated to "Nature" by Mr. Ralph Cusack, of Trinity College, Dublin. Mr. Cusack remarks that when a substance possessing phosphorescent properties is exposed to suitable light vibrations, it is found to glow with a certain brightness after the light is shut off. It further appears that when such substances are exposed under similar conditions for a sufficient length of time, the intensity of the phosphorescent light emitted reaches a maximum which is constant for each substance. If now the temperature of the substance under observation be altered, the other conditions remaining the same, it is found that the maximum intensity of the light emitted varies with the temperature, and that the maximum for any temperature is constant for that temperature. The phosphorescent substances with which Mr. Cusack worked were strontium sulphide and calcium sulphide, excited by means of the light of a spark discharge. The instant the spark stopped, the intensity of the light emitted by the substance was determined by the aid of a photometer devised for the purpose. The principle of this photometer consisted in diminishing light that shines through an aperture of given area, by interposing thin sheets of oiled paper. A slip of glass was also interposed, of the same colour as the light emitted by the phosphorescent substance. As yet this photometer has only been used to compare the maximum intensity of the light emitted from the same substance at different temperatures; and the chief interest of the communication for practical photometrists is in the system of reading its indications adopted by Mr. Cusack. There appears to be some standard light employed with this apparatus, neither the nature nor the value of which is stated. Supposing, however, that with a specimen of calcium chloride at − 40° C. ten papers had to be interposed before the light emitted from the sulphide and that from the photometer were of equal intensity, while at 96° C. only seven papers had to be interposed. Mr. Cusack, thereupon, takes the reciprocal of the antilog of 10, and the reciprocal of the antilog of 7, to obtain what he calls a rough measure of the relative intensity of the light emitted at − 40° and + 96° respectively.

TECHNICAL RECORD.

SOCIETE TECHNIQUE DU GAZ EN FRANCE.

The Annual Congress in Paris.

The Twenty-fourth Annual Congress of the above Society was held in the hall of the Society of Civil Engineers, Paris, on the 15th and 16th inst., under the presidency of M. PH. DELAHAYE. The following abstract report of the proceedings is translated from the "Journal des Usines à Gaz," the official organ of the Société Technique, of which M. Delahaye is Editor.

At the commencement of the business on the morning of the 15th, there were about 150 members present. The report of last year's congress at Clermont-Ferrand having been adopted, the President of The Gas Institute for the current year (Mr. J. Stelfox) was, as usual, elected an honorary member. Then followed the admission of members and associates—there being twenty of the former and eight of the latter. In the course of the past year, the Society lost by death seven members and one associate; and three members and one associate resigned. The numbers now stand as follows: Honorary members, 18; ordinary members, 491; associate members, 106—total, 615. The contributions made to the funds of the Society last year by gas companies and firms amounted to 22,780 frs. (£911), as compared with 22,330 frs. (£893) in the preceding year. The Treasurer (M. Deleury) submitted his report, which showed that at the close of 1896 the Society's capital had increased to 181,183 frs. (£7247); being 10,489 frs. more than it was on Dec. 31, 1895. The retiring members of the Committee (MM. Frère, Seguin, and Lenoir) were re-elected; and MM. A. Coze, Sigaud, and Godinet were chosen as new members. This completed the general business at the morning sitting. The Committee afterwards held a meeting for the purpose of electing officers for the ensuing year; and the following was the result:—

President	M. Delahaye [re-elected].
Vice-President . . .	M. Vautier.
Secretaries	MM. Visinet and A. Lebon.
Treasurer	M. Deleury.

At the afternoon sitting, the usual reports were presented on the various prizes given by the Society. Nineteen communications were submitted at last year's meeting by non-members of the Committee; and it was decided to award four premiums of 250 frs. to each of the following gentlemen: M. Brouwer, for the paper describing his appliance for the automatic removal and quenching of coke; M. André, for his note on the application of gas to bakers' and pastrycooks' ovens; M. Egraz, for the description of his system of lighting and extinguishing gas-burners by electricity; and M. Sar, for his note on searching for underground gas leaks by suction. The papers sent in by members of the Committee were those by MM. Melon, Visinet, Vautier, and Bigeard. The first-named gentleman, it may be remembered, gave an account of the results attending the introduction of prepayment meters at Lille. M. Visinet described the annoyances which may arise from the use of chloride of calcium for preventing the water freezing in gas-meters. M. Vautier dealt in one paper with the photometric results of the enrichment of gas by acetylene when consumed with various burners; and in a further communication he described two series of experiments made with an acetylene burner constructed by him with the view to its employment as a second constant standard for making photometric tests of gas. M. Bigeard's paper contained an account of his use of Welsbach burners for public lighting at Angers. The trials extended over three periods. In the first, the results were not very satisfactory; in the second, they were better as regards the destruction of mantles and glasses; while in the third, in which a new type of lantern was used, time did not allow of the presentation of definite conclusions. In a second paper, M. Bigeard called attention to the injury to which gas-mains are liable by the proximity of electric tramways on the trolley-wire system, as well as of tramway lines generally.

The usual prizes of 200 frs. each were awarded to aged foremen or workmen, for good conduct or long service. Of the total number of applicants, forty were selected. Their ages ranged from 49 to 81 years; and their periods of service from 30 to 44 years—the majority, however, being about 33 years. Medals of honour were bestowed by the Society, acting for the Government, on ten gas workers whose record was considered to entitle them to this distinction.

The President then delivered his Inaugural Address, which was a long and interesting contribution to the proceedings. He commenced by saying he had never better appreciated than he did that day the superiority of those who had preceded him in the office of President of the Society; for not only had they attained the distinction to which he aspired, but, having been placed at the head of important works, possessed authority which he could only envy them. They were therefore in a position to give the members the results of their own and their colleagues' personal experience; whereas he could only offer them what was, of the two, of lesser worth—namely, his own. This confession justified him in seeking outside the sphere of the gas maker for a subject worthy of their attention. He asked them to forget for a moment the retort-house and its plant, condensation and its

mysteries, the sale of residuals, and the best means of extending consumption, in order to consider systems of lighting foreign to the gas industry. Some of these might be incompatible with gas lighting; others might remain adversaries or become allies. But, whether they were competitors or auxiliaries, gas managers would, by making themselves thoroughly acquainted with them, be able to form a more exact idea of the influence they are likely to exercise on the progress of the gas industry. It was from this standpoint that he proposed to speak to them on petroleum, electricity, acetylene, and carburetted water gas. The two former were the competitors to which, up to the present time, gas managers had had to give serious attention—petroleum on account of its cheapness; and electricity by its facility of direct production, and by the persistent setting forth of the alleged hygienic and other merits claimed for it by its advocates. The progress made by these two systems of illumination during the past few years had been considerable. But this had created a greater desire for light; and the consumption of gas had developed regularly. It only remained for gas managers to develop it still more, by not leaving to others the work of satisfying the increased requirements of the public in this respect.

M. Delahaye then proceeded to consider in detail the four systems of lighting he had named. He pointed out that natural mineral oils were the least costly of the illuminating agents. Lighting by petroleum does not require any preparation, and it allows of meters and fittings being dispensed with—in a word, it is a better and cheaper system of illumination than the old vegetable-oil lamp or the candle. If its use were limited to the working classes, gas managers might allow it to pursue its course tranquilly; but, unfortunately, it is encroaching upon the domain of luxurious lighting. Its luminous intensity is no longer limited to 4, 5, or even 10 decimal candles, but reaches 40 and even 50—in the latter case producing heat corresponding to 800 to 1000 units per hour. It is on the latter ground, which is rather the gas manager's, that mineral oils lose the qualities previously regarded as their characteristics; and lighting by petroleum then only becomes economical by leaving out of consideration the expenses of maintaining and attending to the lamps. Setting aside the question of the inconveniences incidental to the use of petroleum—the disagreeable odour and occasional exudation of the oil, and the danger of explosion and fire—the matter may be considered solely from the point of view of cost. Mr. Boverton Redwood, in his work on "Petroleum and its Products," gives the consumption of petroleum as ranging from 45 to 65 grains, or from 41 to 70 grains, per candle-hour, according to the kind of lamp used; and he points out the difficulty of making any exact comparison between the net cost of lighting by mineral oils and the other light-producing agents. M. Delahaye expressed the opinion that whatever kind of lamp might be employed—whether with a round or a flat wick, or with high or low consumption—the cost of petroleum per candle-hour cannot be fixed invariably, because the conditions of combustion change from hour to hour. The average expense must therefore be taken. M. Sainte-Claire Deville found as the result of a series of experiments carried out by him with a number of lamps in the Gas Pavilion at the Paris Exhibition of 1889, that a duplex lamp consumed 78 grammes (1203 grains) of oil per hour, and gave a light of 2·14 carcels (about 20 candles). The luminous intensity began to fall off after the third hour in a six-hour test; and the average consumption of oil was then 36·4 grammes per carcel-hour. M. Cornuault, the Reporter of the Jury in Class 27 of the Exhibition, gave the consumption as between 30 and 40 grammes per carcel-hour; and M. Delahaye thought that he might put it at 35 grammes under normal conditions.

The application of the Welsbach system to the petroleum lamp presented itself quite naturally as a means of decreasing the cost of petroleum; and the experiments which have been made with this object during the past few years seem to have been successful. It is stated that the petroleum incandescent lamp gives the light of from 3 to 5 carcels (28·5 to 47·5 candles) with a consumption of 36 grammes (556 grains) of oil per hour. M. Delahaye expressed the opinion that the maximum luminous intensity may be reached, but that it will not be maintained, because a mere trifle suffices to make the wick flare, and cause at once a deposit of soot. It is much better to regulate the lamp to from 2 to 3 carcels, under which conditions it will go for hours continuously without requiring attention. In these circumstances, the consumption of petroleum per carcel-hour will be something between 12 and 18 grammes per hour; and after some days' use it might not really exceed 15 grammes. It may therefore be taken, from what has preceded, that the minimum consumption of petroleum for the production of one carcel-hour of light in every-day working will be 30 grammes with ordinary round burners, and 15 grammes with incandescent burners; and in Paris the cost of the oil would be 2·25c. for the former, and 1·125c. for the latter. The gas-burners which can be compared with the foregoing are the Welsbachs of 120 and 50 litres (4·20 and 1·76 cubic feet) consumption respectively, the cost of which per carcel-hour, with Paris gas, is 0·6c. for the former and 0·75c. for the latter. Of course, the provinces have the advantage over Paris in getting petroleum cheaper, and in paying less for their gas. But supposing petroleum were only 30c., or even 25c. instead of 60c. per litre, M. Delahaye holds to the opinion that gas at 35c. per cubic metre (7s. 10d. per 1000 cubic feet) will really be the cheaper illuminant, owing to the amount of care required by oil-lamps. All things considered, therefore, he thinks that petroleum is not likely to prove a very formidable competitor with gas.

Turning to electricity, the President said it was not for economical reasons that this source of light would be valued in these days, though at the time it was introduced twenty-five years ago its cheapness was the great recommendation adduced for its substitution for gas in industrial establishments. Then only arc lamps were known; and their high candle-power—amounting to some hundreds of carcels—was compared with the single carcel of an ordinary 5-feet batswing burner. The more moderate writers of the time contented themselves with stating that, light for light, electricity cost less than gas in the ratio of 1 : 2·26 with interest and sinking fund, and of 1 : 7·17 without. Less well-informed people improved upon these figures; and, with the aid of a kindly-disposed Press, the legend of the economy of electric lighting was formulated. It has now been demonstrated that, in undertakings for the distribution of light, the net cost per unit of lighting is higher for electricity than for gas when the motive power necessary for driving the dynamos is obtained from steam-engines; and M. Delahaye believes this is the case in France where the source of power is a waterfall. For his part, he is pleased that electricity is dear whenever a consumer is not in a position to utilize in its production existing plant; and he willingly recognizes certain advantages which it possesses—among others, that it abolishes lucifer matches. He is compelled to acknowledge that it must supply some new want—real or imaginary—of the public, judging by the great extension of electric lighting which has taken place in France, but more particularly in other countries, the last few years.

The next portion of the address consisted of a mass of statistical information in regard to the progress of electric lighting during recent years, drawn from the reports of the Board of Gas and Electric Light Commissioners of Massachusetts and others presented to the Technical Service of the City of Paris. Taking the American figures first, the period covered is that which has elapsed since 1888. During that time, lamps of 10, 15, 16, 20, 25, and 30 candle power were in use; but there has been a marked tendency to unification—preference being shown for lamps of 16-candle power, which for the year 1895·6 were 99 per cent. of the total number employed. The arc lamps are put down at 800, 1200, 1500, 1600, 1700, 1800, 2000, and in six cases 4000 candle power. In the year 1895-6, 48 per cent. of the arc lamps were of 1200, and 50·6 per cent. of 2000 candle power. In the period named, there was an increase of 364,131 incandescent, and 15,193 arc lamps; being an average per annum of 45,516 and 1899 respectively. There has been but little extension of the day use of the electric current for motive power purposes.

With regard to the charge, the current is generally sold by contract; the price including the maintenance of the lamps, &c. As each company has a special tariff, it is practically impossible to get an average. Where the current is sold by meter, the price ranges from 10 to 28 c. per kilowatt-hour—say, an average of 20 c. As to public lighting, M. Delahaye obtained privately the following figures relating to the United States generally: In towns of more than 5000 and less than 30,000 inhabitants, the average charge for 2000-candle lamps is $98·43 per annum, and for 1200-candle lamps $89·23 per annum, where the lighting is permanent. Where a moon schedule is in use, the prices are $92·78 and $81·68 respectively. In towns of more than 30,000 inhabitants, the figures are: For 2000-candle lamps, $107·80 per annum; for 1200-candle lamps, $115·54 per annum—in each case permanent lighting, with few exceptions. Where electricity is sold for public lighting, the price charged is 6·5 c. per kilowatt-hour. From the foregoing figures, it may be concluded that for private lighting and motive power the average charge is 20 c., and the minimum 10 c. per kilowatt hour; while for public lighting it is 6·5 c. In this connection, M. Delahaye gave a series of statistics, in tabular form, showing the general results of the working of 84 undertakings distributing electricity for lighting and motive power purposes for the twelve months ending June 30, 1896; the conclusions drawn from the figures being that the cost of production and distribution and the general expenses, without reckoning capital charges or amortization, is equal to, if not actually more than 6·5 c. per killowatt-hour of electricity sold. Comparing these figures with the charges for gas by 68 companies supplying in the same towns as the electric light companies taken, M. Delahaye arrived at the result that each kilowatt-hour of electricity sold costs to produce from two to three times as much as a cubic metre (35·3 cubic feet) of gas.

Turning to France, the President remarked that the particulars placed at the disposal of the public by the gas and electric lighting companies do not allow of the presentation, with very much precision, of a general comparison between the expenses of production and distribution per cubic metre of gas and per kilowatt-hour of electricity, leaving out capital charges. There is, however, an exception in Paris, where the Gas Company's accounts and those of the Municipality electric lighting station at the Halles Centrales are available. A comparison here becomes possible; and if the accessory accounts are eliminated, so as to get cubic metres on the one hand and kilowatts on the other, the result is not less instructive than that furnished by the American statistics. By "accessory accounts" M. Delahaye

means the receipts for residuals, letting appliances on hire, &c. If these are deducted from the expenses, the outlay incurred in the production and distribution of the lighting agent is obtained, and the cost of the unit can be arrived at. Applying this principle to the accounts of the Halles Centrales for the year 1895, M. Delahaye arrived at the figure of 48·278c. as the cost of production and distribution per kilowatt-hour of electricity utilized. Treating the accounts of the Paris Gas Company for the same year in a similar way, he found the figure to be 10·25c. per cubic metre of gas actually sold—not simply utilized. Consequently, the cost is four or five times greater in the case of electricity than in that of gas. No account is here taken of the capital charges which the Gas Company have to bear, but which do not trouble the Municipality. Though the municipal electric lighting station is regarded as a model one, 16·70 per cent. of its production of electricity is lost, and of the rest only 86 per cent. is sold. Dealing further with the question of electric lighting in Paris, the President gave a summary, in tabular form, of the results of the working of the six private companies in the three years 1893, 1894, and 1895. During these years, there was an increase of 50 per cent. in the number of consumers (4488 to 6865), of 20 per cent. in the number of arc lamps (5557 to 6568), of 65 per cent. in the number of incandescent lamps (201,807 to 335,759), of 50 per cent. in the number of hectowatt-hours of electricity consumed (48,585,689 to 72,319,935), and of 50 per cent. in the gross returns (5,643,689 frs. to 8,319,967 frs.). The provinces, following a bad habit, have imitated the capital, and have established electric lighting undertakings under less favourable conditions than exist in Paris. With regard to the question of suppliers of gas taking up electric lighting, M. Delahaye guarded himself from expressing a definite opinion on the point. He left it to each one to follow his own inclination in the matter, until the substitution of gas-engines for steam-engines naturally converts electric lighting into a bye-product of the gas industry.

The last remark brought the President on to the third branch of his subject—acetylene. He said that if the gas-engine was necessary to transform gas managers into electricians, they were, without doubt, the most important producers and distributors of acetylene in the world. They had probably not yet thought of it, but for a long time, in laboratories, the most convenient way of preparing acetylene was to pass into an ammoniacal solution of cuprous chloride the products of the incomplete combustion of illuminating gas. It was only necessary to open a treatise on chemistry to convince themselves of this. The truth appeared when the new theory was formulated in England as to the luminosity of flames, based on the formation of acetylene by means of less simple and less stable hydrocarbons. The President went on to say, however, that, notwithstanding the facilities it offers, it is not from illuminating gas that it is proposed to extract acetylene. It is preferred to employ carbide of calcium, and to expose oneself to the annoyances, as well as the dangers, incidental to a manufacturing process which demands the most minute precautions. He then proceeded to deal with the production of carbide of calcium by the electric furnace, and the cost of the operation. He considers there is more than one reason for the wholesale selling price of carbide of good quality not falling below 400 frs. per 1000 kilos., so long as it is produced by electricity. Theoretically 1 kilo. (2·2 lbs.) of carbide should give 340 litres (12 cubic feet) of pure and dry acetylene. Professor Lewes, however, speaks of 5 cubic feet per pound, which corresponds to 309 litres per kilogramme. This must be carbide of exceptional quality; and M. Delahaye thinks 300 litres as a maximum is, in general, what should be reckoned upon. With regard to the actual preparation of acetylene gas from carbide of calcium, he remarked that the operation does not present any difficulty. In fact, it appears so simple that no one suspects how dangerous it is to place in the hands of the first comer an apparatus for the home manufacture of acetylene. He then dealt at some length with the risks attending the production and use of acetylene, and the regulations which it has been considered advisable to formulate in regard thereto; quoting those lately issued by Sir V. D. Majendie. While calling attention to the dangers of the new illuminant, however, he did not hesitate to acknowledge that it furnishes a marvellous light, and that it will give a better one when a suitable burner for it has been found. As to price, he said he did not think that, under present conditions, it had any advantage over ordinary incandescent gas lighting, though it certainly produced a more agreeable light.

The question of lighting power, incidentally referred to in connection with acetylene, though of secondary importance in France, led the President to his last subject—carburetted water gas—a paper on which gained one of the Society's prizes two years ago. He pointed out, first, that there are no residual products, properly so-called, in the manufacture of this gas; the quantity of tar collected in the process of cooling and washing being insignificant. As to price, he said that, while it did not appear to be disputable that in England it was higher than that of coal gas, it was absolutely certain that in France it would be double, owing to the price of mineral oil. To this primary drawback must be added a second—viz., that the gas contains a much greater proportion of carbonic oxide than coal gas. M. Delahaye remarked that in the various papers which have been presented during the past two years to English Associations of Gas Managers there have been contradictory statements on these two points. Without entering into controversial matters, he said he thought he could give his audience the materials to enable them to form a personal opinion upon the matter. In the manufacture of carburetted water gas, it was generally reckoned that, for each 1000 cubic feet (28·3 cubic metres), 3 gallons of oil, valued at 4d. per gallon (13·6 litres, at 9·16c. per litre), and from 35 lbs. to 50 lbs. (15·8 to 22·6 kilos.) of coke, would be required—coke being 5s. to 6s. per English ton (7 frs. 37c. to 9 frs. 85c. per 1000 kilos.). He added that if they applied to these quantities of oil and coke the prices admissible in France, the higher net cost per cubic metre of carburetted water gas would be no longer a subject of doubt. He pointed out, however, that, notwithstanding its relatively high price and its dangers, the gas has a number of partisans, and that there are certain advantages attending its manufacture which cause it to be appreciated. These he enumerated; and he quoted the expressed opinions of Mr. Hunt and Mr. Stelfox in favour of the system. To his mind, however, it is only suitable for large works, and in exceptional circumstances. It would be a valuable auxiliary in case of an abnormal and temporary increase of consumption, or the occurrence of any of those disagreeable surprises to which the gas industry, as all others, is from time to time exposed.

The President closed his address with a few remarks on the subject of the price of gas. He said gas managers were reproached on account of their monopoly and their tariffs, though most of them were not the authors of either one or the other. Taking the last accounts of the Paris Gas Company as the basis of his observations on the subject, he showed that, with a sale of 303,709,673 cubic metres of gas at an average price of 26·6c. per cubic metre, reductions of 2·5c. and 5c. per cubic metre would correspond to augmentations in consumption to the extent of 33 and 116 per cent. respectively, which could not be expected to take place in less than ten or fifteen years, in view of the introduction of new and the improvement of old methods of lighting. It followed, therefore, that the limits within which it would be possible to vary the charges for gas are very narrow. Every reduction in price meant a relative immediate loss, which might extend over several years at least. While suppliers of gas did not refuse to make reductions, it was advisable not to undertake to do so before they obtained reasonable compensation. His hearers would know better than he what to understand by this expression, which should be his final word.

The technical portion of the proceedings at the meeting will be noticed in subsequent issues of the "JOURNAL."

WESTERN (U.S.A.) GAS ASSOCIATION.

The Annual Meeting at Cincinnati.

(*Concluded from p.* 1421.)

Mr. F. H. Shelton, of Chicago, read a paper on "The Failure of the Commercial Attempts to Supply Fuel Gas in the United States," in which he said that, after sixteen years' agitation and trial, fuel gas had in every case been a flat and total failure. This was perhaps a sweeping assertion; but the facts of fuel gas history could not be gainsaid. He did not propose to notice various novel schemes which had been attempted under the title of "Fuel Gas," or to discuss the theory or properties, &c., but simply to give a summary of *bonâ fide* attempts to work it as a commercial concern. The first venture of this kind was at Yonkers (N.Y.), where a company was formed in 1880, for the manufacture and supply of "blue," or uncarburetted water gas. While in many respects a genuine attempt to sell fuel gas, it was nevertheless a show plant for facilitating the sale of patent rights. The capital was £47,000; and the Strong apparatus, supposed to be an improvement on the Lowe, was adopted. It turned out a "blue" gas, of 310 to 360 heat units, which was sold unpurified, for fuel only, at 2s. 1d. per 1000 cubic feet. Though established in a district having a population of over 30,000, only 55 customers were secured; and after running for two years, and selling about 30 million cubic feet of gas, the concern was sold to the United Gas Improvement Company. At Lynn (Mass.), with a population of 55,000, a Citizens' Steam and Gas Company started in 1883, with a capital of £48,000, to supply blue gas of about 300 units, unpurified, which was sold at 1s. 3d. to 2s. 1d. per 1000 cubic feet, both by contract and by meter. About 4½ miles of mains were laid; and an output of 200,000 cubic feet per day was reached. But this did not last long. The sulphur in the gas gave a strong odour, and corroded the pipes and fittings. Purifiers were put in, but did not save it, as the low heating power was an objection; and the concern was therefore closed early in 1889. At Troy (N. Y.), a similar scheme was started, with a capital of £80,000; but it came to an end in six months. The franchise was revoked on account of the poisonous nature of the gas; three persons being killed by the breakage of a main. But it was a financial failure from the first, and was regarded as a raid upon the gas business. At the small village of Bellevue (Ky.), a Water and Fuel Gas Company was established, with a capital of £40,000, to supply blue water gas; and here the Fahnehjelm comb was introduced. But in a very short time they were glad to go over to illuminating gas. At Los Angelos (Cal.), there was a similar experience. An attempt to supply blue gas at Omaha

(Neb.) was a total failure. At Terre Haute (Ind.), the Citizens' Gas and Fuel Company was established in 1889, with a capital of £10,000, to work the M'Kenzie process, in which gas was made from steam and oil in an apparatus somewhat similar to a water-gas superheater. Purifiers were omitted at first; but they were soon found to be indispensable. The gas was of variable quality—say, 400 to 560 heat units—but it was claimed to be equal to natural gas. It was sold at 1s. 6d. per 1000 cubic feet, to compete with a mixed illuminating gas at 5s. 3d. At the end of five months, there were only 22 consumers, of whom 8 were shareholders; and in eighteen months, the Company were glad to go over to illuminating gas. At Tacony, a small suburb of Philadelphia, fuel-gas plant was put down by a saw company in 1889; and they also undertook to supply the public. The gas was blue, of 307 heat units value. The gas was sold at 2s. 1d. per 1000 cubic feet at first; but the price was now reduced to 1s. 3d. In 1891, there were 25 customers; and in 1896, only 19—the output being 1½ million cubic feet per annum. At Akron (Ohio.) the Loomis process was introduced on a large scale in 1889, with a capital of £75,000; and the product was sold purified, both for fuel and Welsbach lights, at differential rates, ranging from 1s. 3d. to 2s. 1d. per 1000 cubic feet, so as to compete with coal gas at 5s. 10d. An output of over 100,000 cubic feet per day, supplied to some 300 consumers, was attained; but in about a year the promoters were glad to shut down their works, and go over to illuminating gas. Here the fuel gas had every possible advantage, which rendered its failure more prominent. A few other unsuccessful attempts to work the Loomis process were quoted. Several spirited efforts to introduce the Fahnhejelm comb in connection with blue gas were instanced, including those at Jackson (Mich), at Chicago, St. Joseph (Mo.), Cornwall (Ont.), and Grand Rapids (Mich.), usually with a view of competing with illuminating gas. But in every case the process was discarded after a time. At Boston, the Gas Company made an offer to supply purified Loomis gas for fuel, at 2s. 6d. per 1000 cubic feet; but after a few months, the customers found that carburetted water gas at 4s. 2d. was cheaper as a fuel, and gave up the use of the Loomis gas. The St. Louis (Mo.) Gas Company made a similar genuine attempt to find out if the public really wanted fuel gas. Even the offer of a 1s. 3d. rate only secured about 70 customers, and an output of 30,000 cubic feet per day in that large city; and after six months, the trial was abandoned. At Des Moines (Iowa), Lowe gas partly enriched with oil, so as to raise the heating value, was tried. It was supplied at 2s. 1d. per 1000 cubic feet, in competition with illuminating gas at 7s. 1d.; but after supplying about 7 million cubic feet of the gas to 20 customers, the demand failed, and the works were closed. At Savannah (Ga.), the United Gas Improvement Company tried a similar experiment; but they only demonstrated that the public preferred 28-candle gas at 7s. 6d. to 6s. 3d. per 1000 cubic feet, to blue gas at 2s. 1d. At Louisville (Ky.), it was tried, at 2s. 1d. per 1000 cubic feet, against 5s. 8d. for illuminating gas, and subsequently enriched with oil to 12 or 14 candles. But the Engineer of the Gas Company told him they did not get more than three or four customers; and they gave the matter up in disgust. He might be reminded that fuel gas companies were running at Cottage City, and at Framingham (Mass.). But in reference to both places he quoted from the State reports some figures showing that no profit was earned; and in neither case had a dividend ever been paid. Loomis fuel gas was also introduced at Bridgeport (Conn.) some months ago, and sold at cheap rates; but the principal promoter had stated that they were losing money, and the Company were endeavouring to get powers to make illuminating gas. Summarizing these results, the author said that in the last sixteen years 27 trials had been made, of which 22 totally collapsed; 2 companies were endeavouring to get out of the fuel gas business; and the remaining 3 had never paid a dividend, after six years' operations, and their business was falling off. Of the 27 trials, 5 were made by existing companies, and 14 companies were promoted in districts already supplied with illuminating gas; and there was reason to believe that, though these were called fuel gas projects the real object was to cut in to the existing business, as they had either changed to illuminating gas or were about to do so. A small outlay would convert a fuel-gas works into a full-blown illuminating gas plant. All the genuine attempts to meet an apparent demand for fuel gas had collapsed. Four of them were in places that had never had other gas; but this did not affect the result. Out of 951 gas companies in the United States, only two were keeping to fuel gas, which would not be the case if there was profit in it. The fact was that, after trial by some of the best authorities in the country, it was given up. It was a good vehicle for raiding or exploiting patent rights; but as something that would pay business men to take up, it was a failure. The real cause of this was that its heating value was only 300 to 400 units per cubic foot; while that of illuminating gas ranged from 625 to 750 units. It was only worth half as much as illuminating gas; but it could not be made and distributed at anything like half the cost, to earn a profit. With these facts well known, he contended that anyone promoting a fuel gas company had some other object in view—such as being bought off, or securing a share of existing illuminating gas business.

Discussion being invited, Mr. Thompson said the details given in respect to St. Louis were correct. The fuel gas cost about the same as illuminating gas, but did not do the work so quickly; and therefore people refused it. At Paris (Ill.), fuel gas had also proved a failure. Mr. Donald M'Donald, speaking as one who had charge of a fuel-gas undertaking, fully endorsed all that was said, and considered anyone who undertook to supply artificial gas as a substitute for coal gas was a fool or a knave. But there were several purposes for which it was applicable—such as cooking or heating—for which gas would be used if sold cheaply. High-power gas at a low price was not a success, unless people were taught how to use it. But the public would not have a weak, or a dirty gas; and if not good enough for illuminating, it would not be tolerated for heating. It was no impossibility for gas to come into general use as a fuel; but though appliances had been improved, there was much more to be done. They wanted a line of fixtures in which either gas or coal could be used. Mr. J. R. Lynn said he had been consulted as to a fuel-gas undertaking; and after full investigation, he found the process was inferior to ordinary illuminating gas business. Even a price of 1s. per 1000 cubic feet failed to increase the demand. Mr. Moss said it was evident that, to be a success, a fuel gas company must sell as good gas as was supplied for illuminating, and was practically an ordinary gas company under a new name. In case of an opposition company coming in, it was important to give attention to the heating value of their product. Mr. Summers remarked that a consumer had expressed a preference for ordinary gas at 6s. 3d. per 1000 cubic feet, to fuel gas at 1s. 10d.; considering it quite as cheap, and quicker in action. Mr. Egner spoke in favour of a cheap 300-unit gas. In conjunction with the Welsbach burner, he did not see why it should not be a success; and he thought the real causes of the failures instanced should be carefully investigated. Mr. Evans said that the only fault about fuel gas was that it cost too much. The projects mentioned had been of very great value in demonstrating the advantages of gaseous, as compared with solid fuel. They had stimulated the gas manager to sell cheap gas, and the public to demand something cleaner than coal. He believed the day would come when gas would be used as a fuel for all domestic purposes. Mr. Harbison, after giving lengthy details, said he agreed that the furnishing of a special gas for fuel purposes was a mistake, and could not succeed. The demand for fuel gas could be best met by steady improvement all round, and reductions in the price of illuminating gas; and this should be the aim of the gas industry. General Hickenlooper held that, while it was quite impracticable, in a commercial sense, to make and distribute a fuel gas, there was a quiet revolution going on in public sentiment that would require consideration on the lines of supplying at the lowest possible cost an illuminating gas that would also do for fuel. But he was not a believer in differential prices for gas used as fuel. The improvements in incandescent burners obviated the necessity for keeping up the candle power of the gas at a proportionately increased cost. Mr. Shelton, in briefly replying, said he had endeavoured to write a true history of facts, without fear or favour; and although not at present in favour of fuel gas as generally understood, he was a strong believer in gas for fuel.

A paper on "Leakage" was next read by Mr. E. H. Jenkins, of Covington (Ky.), who observed that, though the subject was not new, it deserved careful attention, and might be discussed with advantage. While he did not question the necessity for care and attention with a view of manufacturing gas at the lowest possible cost, he held that the same care and attention should follow it until actually sold to the user. He touched upon the need for accurate measurement, adjustment of water-line in the station meter, and correction for temperature and pressure. Much of the discrepancy between the gas made and that accounted for was not actually due to leakage. While condensation did not take place to any great extent, there was no doubt that the average temperature at the consumer's meter was below the standard. In a climate like that of Cincinnati, it might be taken as 50°, which would mean a loss of over 2 per cent.; and it must also be remembered that the greater proportion of the gas was sold at the lower temperatures in winter weather. In support of this, he quoted from a paper read before the Gas Institute by Mr. D. Irving, in 1895. But allowing 2 or 3 per cent. on this head, there was still a large margin. According to the Massachusetts State reports, the average leakage for 58 undertakings was 6½ per cent. Dividing the works out into sizes, he noticed that for makes under 10 million cubic feet, the average was 15 per cent.; from 10 to 20 millions, 10¼ per cent.; from 20 to 50 millions, 10¾ per cent.; from 50 to 100 millions, 9¼ per cent.; from 100 to 200 millions, 6½ per cent.; and over 200 millions, 4¾ per cent. Referring to the details of the report, he observed that in some instances local reasons could be given for a large leakage; but in any case it appeared that the smaller the mains the greater the leakage. The larger concerns also had fewer small service-pipes. It was all very well to calculate leakage per mile of main; but the real point was, if 1000 cubic feet was sent out, how much of it was paid for? Several undertakings showed a reduction as compared with the previous year. One had gradually come down to under 3 per cent.; and this was done by relaying all old mains, discarding 2-inch pipes, and taking care to go 3 feet deep. One, with 3½ per cent. leakage, was very particular in the matter of testing, and renewing mains and services. Another effected a saving by replacing all mains under 4 inches in

diameter with wrought-iron pipe. Several showed good results from testing mains; and attention to street-lamp burners and to "slow" meters was also recommended. The chief adjuncts of low leakage were frequent testing, deeply and well laid mains, good soil, moderate pressures, and attention to consumers' meters. The use of a portable pressure-indicator, so as to obtain diagrams from all parts of the district, was advocated. The seams and rivets of the gasholders should not be overlooked, all joints in mains should be well and carefully made, cast-iron pipe of less than 4 inches diameter should be avoided, services should be carefully laid and tapped, soil well rammed, and unsuitable material—such as ashes—should be kept away from the pipes. The question of service-pipes was especially emphasized, as often being neglected. These should in all cases be coated, of not less than 1 inch diameter, and not tapped into small mains, but connected by means of a sleeve-piece. Some details of testing by means of pointed bars driven into the earth close to the pipe, or by isolation, and connection with a meter, were next considered; and strict attention to every report of "a smell of gas" was recommended. In an appendix, a number of tests of various lengths of main-pipe were given.

Mr. Somerville opened the discussion by condemning the system of letting mainlaying by contract to the lowest bidder, which was at first the general thing. He said it was quite possible to lay mains practically gas-tight, and which would remain so if not disturbed or undermined. Temperature was no doubt responsible for some of the loss; and as to condensation, every 7 gallons of liquid pumped out of the drip-boxes accounted for about 1700 cubic feet of vapour or gas at the station meter. If he was building a new works, he would use wrought-iron coated mains, one on each side of the road as near to the outside as possible, and lead services in cement. Mr. Lynn preferred making the corrections for temperature and pressure on the average monthly readings, to the usual plan of doing so daily. Something could be done in the way of protecting consumers' meters from extremes of temperature. Mr. Thompson objected to Mr. Lynn's proposal, as it would interfere with checking the daily results. Comparison by mileage was a fairer way of testing the results at different works, than by percentage. Mr. Copley would like to give a word of warning in respect to sewerage schemes. Nearly a hundred miles of new sewers were laid in his district about three years ago; and the result was that his leakage rose from 4½ up to 19 per cent.; and he had not yet found all the leaks. Mr. A. S. Miller reminded the meeting that the station meter itself should be verified once a year. Mr. Highlands recommended a strict watch on the consumers' meters; and Mr. Evans described an automatic temperature-register. Mr. Jenkins, in replying, said that, instead of correcting for temperature at longer intervals than once in 24 hours, he would prefer to do so every hour, if possible.

Mr. H. Wilkiemeyer, of Evansville, contributed a paper which embodied his experiences in introducing the Welsbach burner for street lighting. While admitting that the arc electric light was well suited for city streets with regular lines of buildings close on each side, he condemned it as useless in suburban districts, where there were lines of trees, and houses some distance back on each side. Under such conditions, the Welsbach burner was much better. He had now 400 in use; the price charged being £4 per lamp per annum. The arc light cost £19 per lamp per annum. During 1896, he fitted up 380 Welsbach burners, mostly in the early part of the year; the breakages amounted to 724 mantles and 50 chimneys. He also noticed that the Welsbach burner was approved of in several other places for street lighting.

Mr. Highlands criticized the paper, and thought it would pay better to sell gas for supplying arc electric lights. He was also surprised to hear a gas man say that the arc light was the best for city streets. Mr. Prendergast said that special precautions were necessary to make incandescent street lighting a success; and he went into details at some length. Anti-vibrators were a necessity in some cases; and chimneys, whether glass or mica, should not be used. There should not be a direct inrush of air to the mantle; and sometimes a wire screen was necessary to keep out insects. He read some reports from the street lighting authorities of New York, giving their experiences in introducing the system, and recommended the use of an enamelled deflector above the burner.

The usual closing business, which included a vote of condolence and regret in respect to the late Mr. J. R. Thomas, was then transacted; and the members afterwards separated.

Coal in Russia.—The output of coal in the various parts of Russia is steadily increasing. According to some statistics only just available, the figures were: Anthracite, 632,389 tons; "Crown" coal, 142,914 tons; coal, 6,171,217 tons. The number of men employed in the mines was 33,453, with 9791 helpers, of whom 21,673 hands and 4253 helpers were in Donez district alone; while Poland accounts for 8088 and 3206 respectively, the Ural district for 1491 and 901, and the Moscow district for 1299 and 838. The recent increase in the output of coal appears to be some 10 to 12 per cent. per annum. The production of coke is also on the increase; amounting to about 410,000 tons.

GERMAN ASSOCIATION OF GAS AND WATER ENGINEERS.

The Report of the Council for the Year 1896-97.

The following is a summary of the report presented at the annual meeting of this Association, held on the 16th inst., at Leipsic. The full text of the report was given in the "Journal für Gasbeleuchtung," the official organ of the Association.

The Gas Section of the Berlin Industrial Exhibition held last year was under the control of the Association; and it is gratifying to know that the exhibits were much appreciated by the general public as well as by technical men. The Association gained an award of honour and a medal for the exhibit. A popular descriptive guide to the section, and a pamphlet on the growth of gas lighting in the last decade, were largely circulated by the Association, and were instrumental in attracting the attention of the daily press to the gas industry. A pamphlet having the title "No House without Gas," was also issued for sale at the exhibition; and it has since been very largely distributed by members among householders, with a view to increasing the number of consumers. The historical interest attaching to many of the exhibits at Berlin was very great; and it was suggested that, at the close of the exhibition, they should be used to form the nucleus of a gas and water museum. It was finally decided to keep the collection of water-meters intact, and at least the more important ancient lamps and burners, in the rooms of the "Urania," where they will be publicly displayed provisionally for one year. The Association's participation in the Berlin Exhibition was satisfactory financially, as only 42·5 per cent. of the guarantee fund has had to be called up. During the year the Association tendered its congratulations to the Municipality of Berlin on the occasion of the Jubilee of the city gas-works.

The Simon Schiele foundation, established for the purpose of giving grants to the younger members of the profession and those about to enter it (to aid them in pursuing their studies at home and abroad), has been placed under the administration of the Association; and a draft of the regulations it is proposed shall apply to it has been sent to members, who will be asked during the meeting to give their approval to the scheme.

The Association of German Gasholder Makers approached this Association with a view to the collection of the large volume of scattered experimental data concerning the construction and erection of gasholders. It was agreed that the two Associations should collaborate. A report on the subject is laid before this year's meeting; and it is recommended that a Commission be appointed for its further investigation.

In accordance with the resolution of last year's meeting, the Association is promoting a prize competition for coke-stoves (see "JOURNAL," Feb. 2, p. 231). The stoves sent in for competition are to be in the judges' hands by Nov. 1; and it is hoped that the practical tests will have been completed and the final report of the Commission on "Heating by Gas" presented to the Association before next year's general meeting.

Herr E. Grahn is still engaged in co-operation with the Association in collecting statistics as to the water supply of German towns, of which about 4000 will be dealt with. The work is now nearly ready for the printer. The Photometric Commission of the Association met on March 15 and agreed upon a comprehensive report which will be presented at this meeting. The Association participated in the conference at the Geneva Congress of Electricians, in furtherance of the establishment of an international photometric standard, and agreed to the recommendations of the Electro-technical Union. The sale of paraffin standard candles by the Association during the year was 2740, against 1070 in the preceding year.

The Gas-Meter Commission has not had occasion to undertake many investigations during the year. The Commission on Heating by Gas entered on a two years' undertaking with a travelling lecturer, Fräulein Hohtmann, who has given cookery exhibitions in many places during the past year. The Commission on Inclined Retorts has an exhaustive report to present to the meeting; but it is proposed that it should continue its labours and collect further information. The Commission on Water Statistics presents its eighth report on the supply statistics of water-works. The Commission appointed to consider the draft of a Prussian Water Bill had the satisfaction of seeing the Bill withdrawn. It is suggested that the Commission should be re-appointed to consider water legislation in general. The Commission on Water-Meter Standardization has nothing to add to its exhaustive report of the previous year. The Commission on Instruction presents a provisional report in which it considers the work of the Carlsruhe Technical School, and the course for gas engineers at Dessau.

The seventeenth report on gas statistics is presented this year, and comprises the working results of 192 gas undertakings, against 189 in the preceding report. With very few exceptions, a considerable increase in make is recorded—thanks largely to the extension of the use of gas for motors and technical purposes.

The membership of the Association has increased during the year from 683 to 717; 51 new members have been elected; while 17 have died or resigned. Among the members we notice residents in France, the United States, Austria, Holland, Switzerland, Italy, and Russia—a sufficient indication of the cosmopolitan character of the leading German Gas Association.

INCLINED RETORTS AT THE CASSEL GAS-WORKS.

Mr. F. Egner, of Norfolk (Va.), in the course of his paper on inclined retorts in Europe (see "JOURNAL," June 15, p. 1355), spoke of the works at Cassel as "ideal." Herr E. Merz, the Manager of the Cassel Municipal Gas-Works thus eulogized, has given in the "Journal für Gasbeleuchtung" for June 19 some particulars of the work there for the two years ending the 31st of March last. The following are the more important results (expressed in English terms):—

The retort-house was built in 1894, when ten Coze settings, each of nine retorts, 11½ feet long, were erected within it. The figures refer to periods of twelve months ending on the 31st of March in each year:—

	Year 1895-96.		Year 1896-97.
Annual make of gas . . . . cub. ft.	143,694,000	..	158,423,000
Maximum make per month . . ,,	18,918,000	..	21,771,000
Minimum ,, ,, ,, . . ,,	6,785,400	..	7,596,100
Coal carbonized . . . . . tons.	13,789	..	15,580
Setting-days per year	1,688	..	1,897
Retort-days ,, ...	14,885	..	16,370
Charges ,, ...	72,538	..	81,830
Setting-shifts (12 hours)	3,070½	..	3,609½
Average make per ton . . . cub. ft.	10,420	..	10,168
,, ,, ,, setting-day . ,,	85,114	..	83,560
,, ,, ,, retort-day . ,,	9,889	..	9,677
,, ,, ,, charge . . ,,	1,978	..	1,942
,, ,, ,, setting-shift . ,,	46,795	..	43,869
Coke made, percentage of coal carbonized	68·50	..	70·00
Coke used for firing ,, ,, ,,	13·40	..	13·16
,, ,, ,, ,, coke made . .	19·50	..	18·80
,, ,, ,, pounds per 1000 cubic feet of gas . . .	29·34	..	25·25
Tar made, percentage of coal carbonized .	4·30	..	4·10

The temperatures of the retorts were observed in a number of instances by means of a Keiser and Schmidt thermocouple. The average was nearly 2000° Fahr.; and the difference between the temperature at the top and bottom did not average more than 8°. The retorts may, therefore, be expected to have as long a life as horizontals. On two days the composition of the gas was as follows:—

	Vol. per cent.		Vol. per cent.
Hydrogen	51·9	..	50·8
Methane	31·4	..	32·2
Heavy hydrocarbons	4·0	..	3·6
Carbonic oxide	7·1	..	7·7
Carbonic acid	2·5	..	2·0
Oxygen	0·1	..	0·2
Nitrogen (residue)	3·0	..	3·5

Both in composition and illuminating power, the gas was similar to that ordinarily made in horizontal retorts.

The retorts were charged with Westphalian coal five times in twenty-four hours by means of Riegel's travelling coal hoppers; and, with tolerable care in charging, the coal was very evenly deposited in the retort. The coal was broken to pieces the size of the clenched hand, and was raised by an elevator to two large hoppers at the ends of the retort-house. If the retorts were carelessly charged, and the temperature at top and bottom deviated considerably, tar collected at the lower mouthpiece, and on cooling hardened to pitch. So long as the bottom of the retort remained smooth, the whole of the coke fell out at once; but after the retorts had been in use for a few weeks, the coke caked to the bottom, and had to be loosened by rods. This was a matter of no difficulty. The coke was in large pieces like smithy coke; and in quenching it absorbed the same quantity of water as coke made in horizontal retorts. The charging plates needed frequent renewal; but they were easily and quickly made at the forge on the works. About 3·5 per cent. of the theoretical number of charges were missed for scurfing. The actual scurfing was more easily done than with horizontal retorts. No repairs to the coal-handling apparatus were necessary. The result of 2¼ years' working of the inclined retorts has been very satisfactory; and two more similar settings will be built during the present summer. The wages per 1000 cubic feet of gas made amounted to 3·06d. in 1895-6, and 3·27d. in 1896-7. Of these amounts, the stokers' shares were 0·84d. and 0·73d.

The following list of Coze settings now in use may be of interest:—

Altona	14	settings of	9	retorts	=	126 retorts.
Chemnitz	9	,,	9	,,	=	81 ,,
Dresden	5	,,	9	,,	=	45 ,,
Danzig	5	,,	9	,,	=	45 ,,
Fredriksberg, Copenhagen .	15	,,	9	,,	=	135 ,,
,, ,, .	3	,,	6	,,	=	18 ,,
Trieste	6	,,	9	,,	=	54 ,,
Malaga	1	,,	9	,,	=	9 ,,
Berlin (English works) . .	26	,,	9	,,	=	234 ,,
Geneva	7	,,	9	,,	=	63 ,,
Esslingen	3	,,	9	,,	=	27 ,,
Vienna	180	,,	9	,,	=	1620 ,,

The New United States Tariff.—According to the new Tariff Bill which has been reported to the Senate of the United States by the Finance Committee, coal tar, crude pitch of coal tar, and products of coal tar, known as dead or creosote oil, benzol, toluol, naphthalene, xylol, phenol, and cresol, come into the list of articles which may be imported free of duty.

ASSOCIATION OF GAS AND WATER ENGINEERS OF AUSTRIA-HUNGARY.

Annual Meeting at Linz.

The Sixteenth Annual Meeting of this Association was held at Linz, in Upper Austria, on the 28th ult., under the presidency of Herr BAUER, of Vienna. The members and friends were welcomed to the town by Herr Pascoletto, the Manager of the Linz Gas-Works.

The President found himself unable to again accept office; and the members, after fruitless endeavours to change his attitude, elected Herr H. Nachtscheim, of Vienna, as his successor. Herr Bauer was chosen as Vice-President; and the following were appointed members of the Committee for the ensuing year: Herren T. Herrmann (Vienna), G. F. Berthold (Pressburg), J. Moll (Eger), P. Auzböck (Döbling, Vienna), and G. Vials (Belvedere, Vienna). A benevolent fund has recently been established; and a number of rules for its administration were approved by the meeting. A contribution of 1000 florins (£83) had been made from the funds of the Association towards the inception of this fund. The receipts from the official organ of the Association ("Der Gastechniker") were rather smaller than in previous years. It was decided that the next annual meeting of the Association should be held in Vienna.

Herr Nachtscheim then read a paper entitled "A Review of the Incidents and Improvements of the Past Year in the Gas Industry." He gave his audience a striking and lucid picture of the present advanced position of gas manufacture. He considered that the industry had indirectly profited largely by the exhibits in the Gas Section of the Berlin Industrial Exhibition, and at the Millennium Exhibition at Buda Pesth. He then referred to the application of the incandescent gas system to street lighting, and to the hygienic advantages of the system for general use. He did not fail to speak of the benefits gained by the use of "Holophane" globes and "Jena" chimneys. He directed special attention to the improvement in incandescent lighting effected by the recent introduction of Jena chimneys with side orifices for air admission (see *ante*, p. 77). He then proceeded to discuss appliances for the automatic ignition of gas-burners. We trust to be able at an early date to lay before our readers some extracts from this very capable *résumé* of the year's progress.

Herr Berthold presented some notes on the relative merits of nuts and coke as furnace fuel. He said he had found coke the better fuel; but at local prices it was more profitable to sell all the coke. He had been able to minimize the formation of clinker from coke on the furnace-bars by the introduction into the fire-box of a pipe for the admission of steam. He then made a short communication on tramway traction. In Pressburg, they are beginning to substitute the cable system worked by gas-engines for the electrical system with overhead conductors. The latter not only disfigure the streets, but are positively dangerous. At the unveiling of the Maria-Theresa monument in Pressburg, the fracture of a conductor through too high tension caused the death of an officer's horse and a bad fall to the rider.

Herr Blum, of Berlin, made a few remarks on the benzol question; and then Dr. Alto Arche, of Vienna, gave an interesting lecture on "The Heating Effect of Gas-Stoves of Various Systems." We hope to give a summary of this lecture shortly. Herr Blum then described, by the aid of models, a new patent gas-valve, Jäzer's pump for liquor-wells, and an apparatus for preventing the choking of pressure-gauges by impurities in the gas. Herr F. Lux, of Ludwigshafen, stated that protection was being sought for the Pfudl day and night gas-meter, and that the patent laws therefore prevented him from then describing it; but his paper upon the subject should be published later in "Der Gastechniker." Herr Lux tendered a contribution of 100 florins to the benevolent fund.

A vote of thanks to the retiring President brought the proceedings of the meeting to a close.

The Progress of Electric Lighting.—In an article on "Science and Industries of the Queen's Reign," by Mr. H. C. Marillier, which recently appeared in the "Pall Mall Gazette," the writer called attention to the fact that in 1831, six years before the present reign began, Faraday made his historic discovery that an electric current is induced in a conductor when it is moved so as to cut the lines of force of a magnet. Out of this discovery arose the dynamo-electric machine. The first application of the electric light for lighthouse illumination was at the South Foreland in the year 1858—a Holmes machine being employed for the purpose. Very little headway was made with lamps till Jablochkoff, in 1876, produced his famous "candle." Jablochkoff arc lamps failed rather from want of economical and trustworthy generating plant than from any other cause. They died out even before the general decay of the electric lighting industry which followed the Act of 1882; and they have not been revived in this country. Electric lighting for interiors and for general use did not come in until after 1879, when Swan in England and Edison in America brought out the incandescent lamp. This invention was followed by a rush of electric lighting schemes, most of which were doomed to failure by the Act above referred to. After the new Act was passed in 1888, electric light began to take rank as a commonplace of modern life.

REGISTER OF PATENTS.

Operating Gas-Cocks.—Simons, C. E. G., of Merthyr Tydfil. No. 8612; April 24, 1896.

This apparatus for operating—through the medium of compressed air, or hydraulically or hydrostatically—levers or plugs of gas-burner cocks (more particularly of incandescent burners fitted with pilot-lights) consists of a pair of elastic bags placed in a suitable holder, such as a casing communicating by pipes of different internal diameter with the pipe leading to the source of supply of the motive agent. The bags act on a plate connected, either directly or indirectly, to the lever or cock, and adapted to tilt backwards and forwards as the bags are distended and exhausted.

Anti-Vibration Device for Incandescent Gas-Lamps.—Redman, T., of Bradford. No. 11,116; May 22, 1896.

The patentee proposes to attach to the reflector or some other portion of the lamp-frame, one or more rods for suspending the lamp by a hook or ball-joint supported by a spiral spring or other elastic cushion, in such a manner that any vibration given to the lamp column is absorbed before being transmitted to the lamp. Between the burner and the reflector is a chimney; and above the reflector and mantle is a metallic chimney, at the top of which is a hood, with another of smaller size above it, in connection with a flash lighting-tube. The bottom end of the tube is prepared with a spoon or cone, having the base downwards; so that, on applying a light to the hood, the gas escaping up the flash lighting-tube is ignited, and the gas at the burner lighted without having to open the lamp.

Gas-Engines.—Day, J., of Weston-super-Mare. No. 11,307; May 23, 1896.

This invention refers to engines such as those described in patents Nos. 6410 and 9247 of 1891, No. 18,513 of 1892, and No. 15,514 of 1895, whereby with a given charge of air and gas (or of air and oil) power may, it is claimed, be obtained more economically than has been hitherto the case. The invention further relates to an improved method of, and means for, cooling the cylinder.

The engines are constructed to work preferably with an impulse at each revolution; and two or more are coupled together. The total charge of air and gas is smaller than is usually the case for (say) a two-cylinder engine; and, after being compressed, ignition takes place in a tube or chamber between the two cylinders. Consequently it operates the pistons simultaneously. One engine is constructed to draw in and compress the air and gas, for the purpose of charging the working cylinders; the connections between the air and gas being so arranged that, as far as concerns the operations of charging, one engine performs double duty—the result being that increased expansion, and a lower terminal pressure at the moment of exhaust, are obtained.

A further improvement consists in the means employed for the utilization of air instead of water, to keep the cylinders cool. The cylinders are provided with jackets; and air is drawn through them to be utilized eventually to form part of the charge for the engine. By this means, the air is also warmed before it reaches the cylinder. The air-jacket may be of ordinary construction; but it is preferred that the air should cover as large a surface of the outside of the cylinder as possible. For this reason, the cylinder is provided with a number of thin fins, either vertical, helical, or horizontal.

Acetylene Gas Lighting.—Moreau, G., and Poulhiès, A., of Paris. No. 11,581; May 27, 1896.

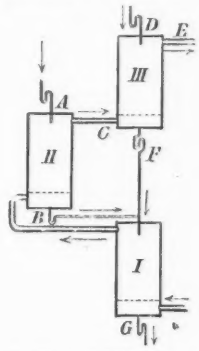
The patentees claim as their invention the utilizing of "mixtures of gas rich in carbon with combustible gases or gaseous mixtures, and more particularly the mixture of acetylene with hydrogen giving a non-fuliginous flame, which produces great light." For carrying into practice the system of lighting thus claimed, an installation comprises two distinct gasholders—one receiving hydrogen produced by the customary process, and traversing a pressure-regulator formed by a float in contact with the gas, and connected with a sleeve which will close the admission of gas when the pressure causes the float to move downwards; the other holder receiving acetylene produced by the decomposition of calcium carbide by the water vapour—a pressure-regulator with a float interrupting the admission of the water vapour when the pressure becomes too great in the holder. The gases then escape from their respective holders, and arrive simultaneously through branches at burners, where they form two converging jets, which produce by their union a flame in the form of a "butterfly;" the mixing of the two gases being in this manner able to take place only at the outlet of the burner. The installation for mixing in any proportions the acetylene with the hydrogen in a single holder comprises two meters, which supply determined volumes of each of the parts of the mixture, and a distributing system in which the mixture already formed arrives, and which sends the latter to the holder. The arrival of the mixture, regulated by the pressure in the holder, is through the medium of an articulated system upon which the bell of the holder acts when it reaches its extreme positions. There is also claimed an expanding burner with two convergent pipes, in one of which a gas rich in carbon (such as acetylene), and in the other a gas (such as hydrogen) which is blown into the flame of the rich gas, arrives, and corrects and regulates the flame—the mixing not being able to take place before combustion.

Manufacture of Acetylene Gas.—Atkinson, J. E., and Labouchere, J. M., of Liverpool. No. 13,147; June 15, 1896.

This apparatus consists of a combination of a gasholder and water-supply tank with generators adapted to hold the carbide of calcium, and separately connected to the supply-tank through an air-vessel and a non-return valve. The generator is provided with a perforated conical top, through which the water passes; the quantity being regulated in virtue of the rise and fall of the water in the bell, due to variations of pressure and variations of displacement by a specially shaped bell, with a dished top. Combined with the generator is a sealing-device, adapted, as the bell of the gasholder descends, to seal a depending rim on the bell, and permit of the withdrawal of the carbide container through a door in the top of the bell without interrupting the gas supply.

Removing Sulphuretted Hydrogen from Gases.—Strache, H., of Vienna. No. 14,943; July 6, 1896.

The method generally adopted for the removal of sulphuretted hydrogen from illuminating gas, water gas, or the like by means of hydrated oxide of iron by the dry process, involves (says the patentee) a considerable amount of labour, on account of the changing of the filling of the purifier, and the requisite regeneration of the material; and it necessitates (more especially in large plants) the use of extensive purifiers, which occupy a considerable amount of space, and, moreover, the changing of the purifiers causes loss of gas, and consequently nuisance to the neighbourhood. The present invention, therefore, is designed to effect the removal of the sulphuretted hydrogen by a wet process in scrubbers or similar gas vessels or chambers, with continuous motion.



Three scrubbers Nos. I., II., and III. (shown diagrammatically in the engraving) are filled with pieces of acid-resisting solid material of large surface—such as glass, earthenware, pumice, or the like. The gas to be purified enters the lowermost scrubber No. I., and is there freed from the greater part of its sulphuretted hydrogen, and passes with the undecomposed residue of sulphuretted hydrogen into scrubber No. II. Into this scrubber, concentrated nitric acid drops from above (from A), and removes the remainder of the sulphuretted hydrogen. The sulphuric acid formed, and the aqueous solution of nitrous acid, flow through B into scrubber No. I. The purified gas, mixed with the nitrogen tetroxide and nitric oxide produced, passes into scrubber No. III. at C. Water flows into scrubber No. III. from above at D, and dissolves the nitrogen tetroxide out of the gas, and forms nitric acid and nitrous acid. The purified gas, mixed with nitric oxide, passes out of the apparatus at E; while the aqueous solution of nitric acid and nitrous acid passes into scrubber No. I. through a direct communicating pipe or conduit F, and on the way mixes with the nitrous acid from No. II.

In this manner, an aqueous liquid passes into scrubber No. I., which liquid contains some sulphuric acid, nitric acid, and nitrous acid. The last-named decomposes into nitric acid and nitric oxide gas, and passes away through Nos. II. and III. with the gas; while the aqueous solution in No. I. now contains principally nitric acid, together with sulphuric acid and a small quantity of undecomposed nitrous acid. This nitric acid effects the decomposition of the greater part of the sulphuretted hydrogen with the separation of sulphur, so that in No. II., as above stated, only a small quantity of undecomposed sulphuretted hydrogen is left; therefore also not much sulphuric acid is formed therein. The nitrous acid formed in No. III. decomposes again immediately into nitric acid and nitric oxide gas; so that by continuous combined operation, it is gradually transformed entirely into nitric oxide gas. A small quantity of undecomposed nitrous acid runs away from the waste outlet-pipe G of scrubber No. I. with water and a little sulphuric acid. The purified gas passing away at the outlet E of scrubber No. III. is, however, mixed with nitric oxide gas. This can be absorbed by water after a suitable quantity of air or oxygen has been added to it; the nitric oxide, with oxygen and water, being converted into nitric acid. It is, however, more advantageous to add the requisite quantity of air or oxygen to the gas before it enters scrubber No. I., since the nitrous acid formed therein is then continually reconverted into nitric acid. The nitrous acid or nitric acid here acts as an oxygen carrier; and so the smallest quantity can decompose a very large (theoretically, an infinitely large) quantity of sulphuretted hydrogen with separation of sulphur. At the same time, the added quantity of air can be so proportioned that not the slightest amount of nitric oxide passes out at E, but is all returned to No. I. in the form of nitrogen tetroxide or nitric acid. The consumption of nitric acid will then depend only upon the small quantity used for forming sulphuric acid, and upon the small quantity of undecomposed nitrous acid which runs away at G, as above mentioned.

The sulphur separated in No. I. partly settles on the filling material, and can be obtained therefrom directly as pure sulphur, by melting it off after drying. Another part of the sulphur is deposited from the discharged fluid in the form of porous lumps; and in this case it can be removed therefrom directly.

The removal of sulphuretted hydrogen from gases can also be effected so that a small part of the gas is allowed to pass through concentrated nitric acid; and the nitric oxide produced mixes with the main portion of the gas, with or without the addition of air or oxygen. The purification is, however, in this case not so rapid and complete as when all the gas passes in contact with the concentrated nitric acid.

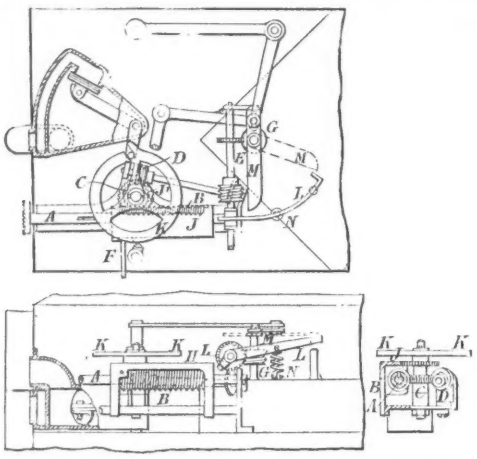
Fittings for Gas-Lanterns.—Cripps, F. S., of Great George Street, S.W. No. 15,105; July 8, 1896.

When using incandescent gas-burners—in order to prevent the damaging effects caused by dust and sudden gusts of wind, the patentee proposes to filter the air through some fibrous or woolly fabric—such as cotton wool, asbestos fibre, or woven material—of sufficiently open nature to permit "a free, full, and uniform supply of air for the efficient consumption of the gas and the maintenance of draught, and at the same time to catch or filter out any dust or other solid matter which might damage any part of the gas-burner or mantle within." The filtering

material—contained in an air vessel, receiver, or director below or above the burner, or in any other convenient position which would necessitate the air passing through it in order to enter the lantern or burner within, not only prevents dust passing, as air is drawn in when the gas is alight, but it prevents air being blown in either at the top or bottom or any other part of the lantern to which it may be applied, whether the gas be alight or not. There is no illustration attached to the specification.

Prepayment Gas-Meters.—Peebles, D. B., of Edinburgh. No. 15,203; July 9, 1896.

The object of this invention is to secure a closer agreement between the quantity of gas actually passing through the meter and the action dependent on the prepayment coins.



In one arrangement, a spindle A has rotation imparted to it corresponding to the coins inserted by means of mechanism such as described in patent No. 24,231 of 1894. The spindle is without longitudinal movement; being held in a frame fixed to the body of the meter. It has on it a tube B, capable of moving along it, and made to turn with it by a feather and groove. The tube has a screw or worm-thread formed on it; and it gears with a worm wheel C, capable of turning about a fixed axis in the frame. Gearing with the wheel C is a worm D, arranged to be turned by the action of the meter when gas passes through it. This meter worm is on a shaft, which has on it a worm-wheel gearing with a worm on a shaft E, which has on it a worm-wheel driven by the usual worm G, turned by the vibrating arms of the meter mechanism. The meter-worm D may be applied to the worm-wheel C, with its axis in any position in the plane thereof, which allows of it being connected direct to the meter mechanism.

When the spindle A is turned, the tubular worm B screws itself along by its action on the worm-wheel C, which cannot revolve on account of the meter-worm D; and the worm B is made to move an indicating pointer F on a frame H, through which the spindle A passes—the tubular worm being held between projecting parts of the frame, which also extend downwards, and by bearing on it prevent the frame H from being turned with the tubular worm. This frame has also formed on it rack-teeth J, which gear with a pinion loose on the axis of the wheel C. This pinion is in a piece with a disc K, which, by a notch in and a projection on its rim, acts on a lever-spindle, which opens and closes the gas inlet-valve. When the meter passes gas, the meter-worm D turns the wheel C, which, acting on the coin-worm B as on a rack, moves it back towards its starting point. The coin-worm B is arranged to act on the valve, so constructed as to not completely close the gas-inlet, but to diminish the supply as a warning that the quantity of gas paid for is nearly consumed. If, however, the consumption of gas continues without a fresh payment, a lever L, loose on the spindle E, has one end acted on by the sliding frame H, so as to bring its other end into the way of the tangent M of the meter mechanism; and by preventing further action of the meter, stops the passage of the gas. The lever L is moved into the path of the tangent M against the action of a helical spring N; this spring (on the withdrawal of the frame H) taking the lever L clear of the tangent.

Manufacture of Carbides.—Bullier, L. M., of Paris. No. 16,255; July 22, 1896. Date claimed under International Convention, Dec. 28, 1895.

With a view to increase the production of carbide of calcium in an electrical furnace from a mixture of 56 parts of quick lime and 36 parts of carbon (in accordance with patent No. 2820 of 1895), as well as to facilitate the operation, the present invention has for its object to reduce as much as possible the temperature at which the reaction is produced by facilitating the fusion of the matters brought in presence of each other. As carbon volatilizes before melting, the patentee p ints out, it is the metallic salt or oxide that can be thus acted on; and the present proposal consists in adding to the mixture a substance which will act as a flux for the salt or oxide. The flux, by lowering the point of fusion— of lime, for example, when producing carbide of calcium—enables the reaction to be performed at a less elevated temperature. The material preferably employed in this case as a flux is fluoride of calcium (fluor spar), which may be added to the mixture in variable proportions according to the quality of the product it is desired to obtain, and also to the manner in which it is desired that the operation should be conducted. For example, by the addition of 10 per cent. of fluoride, the product is rendered much more fusible, and is obtained in the form of a highly fluid bath, which can easily be run off; and the manufacture in a continuous manner is possible.

Generating and Storing Acetylene.—De Sales, G. de R., of Lyons, France. No. 2292; Jan. 28, 1897.

This invention relates to apparatus in which the production of the acetylene gas is automatically regulated according to the consumption, and in which the gas is stored in two separate portions which are in communication with each other in the direction of the consumption only, and not in the return direction towards the interior of the apparatus.

The apparatus consists of a vessel or reservoir adapted to contain water; and a bell whose mouth dips into the water, and whose upper part is fitted with a syphon tube provided internally with a ball-valve. Its exterior end dips into the water contained in a washer mounted at, and surrounding, the upper part of the bell; and it is fitted with a gas outlet-tube perforated so as to communicate with an elastic air-tight bag or pocket for storing a small volume of gas for immediate consumption. The receiver for containing the carbide cartridge communicates with the interior of the bell by a tube fitted with a valve, adapted to be operated by hand from the exterior of the apparatus, so as to start or stop the generation of gas. A cap is provided to enclose the receiver and separate the carbide cartridge both from the atmosphere and from the reservoir; while a safety-device in connection with the upper part of the vessel prevents over-pressure therein.

Coin-Freed Gas-Meters.—Goulson, J., of Berlin. No. 16,891; July 30, 1896.

This apparatus is shown in part sectional front view and plan by fig. 1; in vertical section in fig. 2; and part external front view in fig. 3.

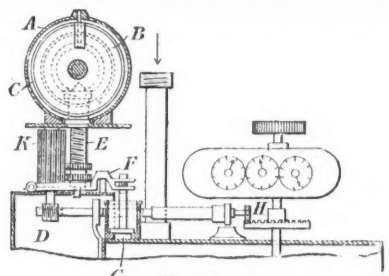


Fig. 1.

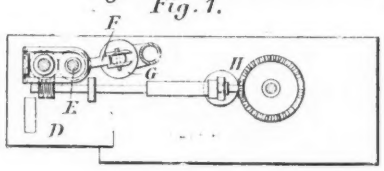
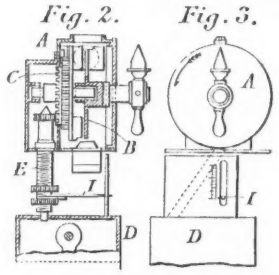


Fig. 2. Fig. 3.



In the casing A, having at its top a coin-slot, is mounted a wheel B, having on its periphery a pocket adapted to take about half the width of the coin, and another wheel C having two pockets opposite one another. The wheel B can be turned by a handle without moving the wheel C; but on a coin being inserted so as to occupy the pockets of both wheels, on turning the wheel B half round, the wheel C is also turned half round, and the coin drops out into a receptacle D below. A number of coins may be thus introduced in succession; the wheel C making half a revolution for each coin introduced. The wheel is geared to a screw-spindle E, the nut on which, when the meter is inert, bears upon a lever F, and keeps the gas-valve G closed. But when the screw E is turned by the revolution of C, the nut is moved from the valve-lever, so as to allow the valve G to open and admit gas to the meter. The counter mechanism of the meter is connected by gear H to a pinion K, having long teeth engaged by teeth on the periphery of the nut on the spindle E. As the counter mechanism revolves, the nut is turned back, and moves along the spindle until it again reaches the valve lever, closes the valve, and stops the meter. The handle on the wheel B is always brought to the position shown in fig. 3 when a coin has to be introduced; and the nut on E is grooved to receive the fork of a pointer I, which projects through a slot graduated at the side, to show the amount of gas still to be consumed until after a certain number of coins have been introduced.

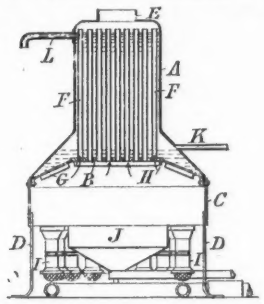
Generating, Holding, and Burning Acetylene Gas.—Franco, Don Carlos B. y, of Barcelona. No. 5236; Feb. 26, 1897. Date claimed under International Convention, July 27, 1896.

This appliance for generating, holding, and burning acetylene gas is shown in the illustration accompanying the specification, fixed in the centre of a two-light pendant—being evidently designed for use in small dwelling-houses. The claims for the invention sufficiently indicate its scope. They are: (1) The separation of the water needed for the decomposition of the carbide in two reservoirs united by a tube constantly open while the "gasogene" works. (2) The entrance of the moisture to the carbide for producing the necessary reaction by utilizing the porosity of any substance that will allow the liquid to infiltrate. (3) The mode of drying, condensing, and enriching the gas by getting rid of the watery vapour produced at the same time as the acetylene by passing the gas in contact with completely dry carbide of calcium. (4) A fixed or portable "gasogene" for producing acetylene gas, in which the water arrives in

contact with the carbide of calcium to produce a reaction by passing across a porous substance which allows the liquid to filter—such as wicks of any texture, porcelain, earthenware, or porous metal exits, "or all other substances or preparations which have the property of porosity, and in which the gas after its formation is dried, condensed, enriched, and rectified by being brought in contact with completely dry carbide of calcium."

Gas Water-Heater.—Fletcher, T., and Fletcher, Russell, and Co., of Warrington. No. 4137; Feb. 16, 1897.

This apparatus for heating water continuously by means of gas consists of an external cylindro-conoidal casing A, to the lower end of which is secured the dished tube-plate B, with its concave side downwards. The lower edges of the casing and of the tube-plate form closely fitting cylindrical surfaces, rivetted to the casing C, supported on legs D. The upper portion of the casing A terminates in a short flue-tube E.



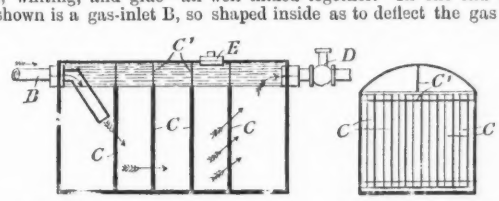
Before the apparatus is closed, closely arranged vertical tubes F are fitted to extend well above the water-level. The tube-plate has cast upon its under surface an annular series of radiating webs G, and a projecting ring H. Immediately below the webs, there is a circular series of atmospheric burners I; and below the tubes F, there is placed a drip-funnel J. The hot gases from the burners ascend through the vertical tubes F, and escape at E. The water to be heated is supplied through the pipe K; and the hot water issues through the outlet-pipe L.

Manufacturing Acetylene Gas.—Alexandre, H. E., of Barcelona. No. 5913; March 5, 1897.

The apparatus forming the subject of this invention substantially comprises: A calcium carbide receptacle, divided vertically into several compartments, which only communicate with one another at their upper parts, so that water entering and completely filling one of the compartments will pass to the second compartment, and so on, until the whole of the carbide is exhausted. Another essential feature is that the water required for the reaction of the calcium carbide is drawn from the reservoir of the gasholder by means of a cock or tap, actuated by a rack-bar fixed to the bell-shaped cover of the holder. A third feature is a curved gas-pipe leading from the generator to the holder, so arranged that, while disengaged in water, the gas may be washed or purified before being stored in the bell of the holder.

Composition and Apparatus for Enriching Gas.—Stephenson, A. A., of Sydney, N.S.W. No. 7991; March 29, 1897.

For the purpose of forming an enriching composition, the patentee proposes to take ¼ pint of oil of cloves, and 2 pints each of ether, petroleum, gasoline, and kerosine; also ¼ lb. each of powdered camphor, resin, whiting, and glue—all well mixed together. In one end of the box shown is a gas-inlet B, so shaped inside as to deflect the gas down



into contact with the enriching composition at the bottom, in and about wicks C. At the other end of the box is an outlet-union D. A charge-hole E, with air-tight cap, is fixed at the top of the box; and through it the enriching composition is passed in. Extending laterally across the box are a number of wires or rows of wires C'. The lowest row is about ½ inch from the bottom of the box, while the top row is a greater distance from the top. The absorbent material is fixed at the top and bottom to these wires by sewing. The wicks may, says the patentee, be of any desired width—by preference ½ inch, and placed about ¼ inch apart. He finds by experiment that, "after they have been used for some little time, they become thoroughly coated or caked with the enriching composition, and present a crystallized surface from which highly successful results are attained."

Water-Meters.—Meinecke, H. S. P., of Breslau, Germany. No. 8030; March 29, 1897.

This invention is an improvement upon the water-meter described in patent No. 26,859 of 1896; and it has for its object to render such meters more sensitive, and to secure them against slight frost.

The patentees propose to employ a cranked shaft, for converting the tumbling motion of the disc-shaft into rotary motion for the main shaft of the counter, and having its bearing in a support firmly connected to the inner or disc casing. It is arranged in combination with a coupling between the shaft and the main shaft of the counter, so as to enable the distance between such parts to vary without their becoming disengaged from each other. Means are also provided for adjusting the disc in the casing by altering the distance of the friction-roller on the tumbler shaft of the disc, so as to cause the surfaces of the disc to fit against the inclined walls of the inner casing.

Bunsen Burners.—Lecompte, A., and Loeser, I., of Paris. No. 8385; April 1, 1897.

This invention relates to a bunsen burner capable of being used under the galleries of incandescent burners, and arranged more especially to work with very low gas pressure. The combination in question consists of an ejector, having a single central hole of conical shape forming an angle of about 30°, with two converging cones arranged one above the other, and having different angles—the lower cone having an angle about equal to the angle at which the gas expands, and the upper one having an angle considerably greater (preferably about seven to nine times greater) than the angle of the lower one.

APPLICATIONS FOR LETTERS PATENT.

13,928.—Crossley, W. J., and Holt, H. P., "Valves for internal combustion motors." June 8.
13,938.—Small, F., and Clarke, T., "Shade holders for gas and electric light fittings." June 8.
14,015.—Trendel, F., "Production of acetylene gas." June 8.
14,022.—Memmo, R., "Manufacture of carbide of calcium." June 8.
14,041.—Healy, P., and Crawford, R., "Gas-heated irons." June 9.
14,056.—Ireland, M., "Holding in position water and gas fittings when soldering same to metal pipes." June 9.
14,090.—Jimeno, E., "Production of acetylene." June 9.
14,091.—Jimeno, E., "Gasholders for acetylene and other lighting gases." June 9.
14,112.—Miles, E. B., W. P., & A. H. P., "Automatically turning on and turning off gas in lamps and burners, and other gas contrivances, or water in pipes or mains, at any time desired." June 10.
14,200.—Glover, R. T. & J. G., "Compensating wet gas-meters." June 10.
14,208.—Haviland, F. H., and Murch, W. H., "Automatically generating, storing, and supplying acetylene gas." June 11.
14,221.—Vincent, F., and Whiteside, W., "Self-locking gas-tap." June 11.
14,240.—Muir, J. S., "Improvements in gas lighting, and in apparatus connected therewith." June 11.
14,259.—Kayser, H., "Incandescent bodies for gas and other lighting." June 11.
14,260.—Rangabe, O. R., "Generating acetylene gas." June 11.
14,264.—Bal, F. de, "Incandescence hoods or mantles for illuminating purposes." June 11.
14,273.—Johnson, C. M., "Manufacture of gas for lighting, heating, and motive power purposes." June 11.
14,274.—Leigh, H. H., "Production of acetylene gas." A communication from F. Saldana. June 11.
14,275.—Leigh, H. H., "Lamps for generating and burning acetylene gas." A communication from F. Saldana. June 11.
14,277.—Silbermann, A., "Incandescent gas-burners." June 11.
14,287.—Beechey, C. G., and Wright, A. T., "Automatic gas-meters." June 12.
14,313.—Gaskell, G. W., and Reeve, R. F., "Generating gas by the addition of a solid to a liquid." June 12.
14,368.—Probert, E. E., "Incandescent gas-lamps principally intended for street use." A communication from A. C. Niermeyer. June 14.
14,397.—Wattles, L. H., "Generation and utilization of hydrogen gas and electricity for motive power, lighting, and heating purposes." June 14.
14,405.—Harrison, H. T., "Prepayment gas-meters." June 14.
14,406.—Boult, A. J., "Manufacture of acetylene, sulphuretted hydrogen, carbonic acid, and other gases." A communication from A. Vandenberghe. June 14.
14,449.—Richmond, E. W. T., "Gas-fire places or stoves." June 15.
14,455.—Capel, H. C., "Gas-engines." June 15.
14,471.—Jones, H. A., "Gas apparatus." June 15.
14,493.—Stedingk, H. de, "Improved mode of obtaining heat from oil or gas stoves." June 15.
14,499.—Steinbach, J. C. J., "Mantles for incandescent gas-burners." June 15.
14,505.—Lake, H. H., "Improvements in the manufacture of illuminating gas." A communication from A. Piatti and Co. June 15.
14,530.—Sykes, E. & E., "Valves for water or other liquids or fluids." June 16.
14,538.—Richmond, E. W. T., "Gas-heated water heaters or boilers." June 16.
14,555. Smith, C. C., "Acetylene gas generators." June 16.
14,585.—Shann, M. H. C., "Internal combustion engines." June 16.
14,602.—Himmel, G., "Lamps or lanterns for street lighting and similar purposes." June 16.
14,615.—Giles, E. W., "System of water-pipes for buildings." June 16.
14,661.—Bower, G., "Automatic gas pressure-regulators and induction jets." June 17.
14,689.—Lejeune, N., "Acetylene gas producers." June 17.
14,700.—Bean, H. R., and Ringwood, H., "Purifier and enricher for acetylene gas." June 17.
14,724.—Mohr, O., "Supporting rods for incandescence bodies." June 17.
14,736.—Rowbotham, W., "Explosion engines." June 18.
14,742.—Fowler, T. R., "Manufacture of acetylene gas." June 18.
14,750.—Riley, R., "Chandeliers." June 18.
14,758.—Walker, C. M., "Gas-lamp." June 18.
14,822.—Smith, W. B., "Refractious substances to be heated by gas, including oxy-hydrogen, for illuminating." June 18.
14,835.—Gaskell, G. W., and Reeve, R. F., "Acetylene gas light apparatus for use in photographic studios." June 18.
14,851.—Naylor, S., and Steel, R., "Gas-engines." June 19.
14,874.—Crossley, W. J., and Atkinson, J., "Gas-engines." June 19.
14,890.—Hutchinson, W., "Incandescence gas-burners." June 19.
14,905.—Sefton-Jones, H., "Production of acetylene gas." A communication from P. P. H. Macé. June 19.
14,929.—Légé, A. J. B., and Pennellier, A. D., "Production and burning of acetylene gas." June 19,

CORRESPONDENCE.

We are not responsible for the opinions expressed by correspondents.

Automatic Regulation of Pressure.

SIR,—Referring to Mr. W. R. Chester's very able paper on the above matter at the recent meeting of the Gas Institute, some eight years ago Mr. Cloudsley, of Messrs. W. & B. Cowan, Limited, wrote me on the subject of automatic pressure regulating at points distant from the works; submitting the idea of running 1-inch service-pipes from the governor to extreme points, to bring back the pressure to actuate the governor. In reply, I wrote that the idea appeared excellent; but why not use *electricity* instead of a service-pipe to do the work? Mr. Cloudsley seemed to think there would be difficulties. It is satisfactory to see that my idea has been realized. Automatic regulation may be effected, however, in a far simpler manner by using the Gareis or Ledig Automat. We have a Ledig at work, and it leaves nothing to be desired.

Copenhagen, June 24, 1897. F. D. MARSHALL.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following further progress has been made with Bills:—

Bills read a second time: Nottingham Corporation Water Bill, St. Neots Water Bill.

Opposition withdrawn: Gas Orders Confirmation Bill, No. 2 (in respect of the Market Harborough Order).

Bills read the third time and passed: Gravesend and Milton Water Bill, Water Orders Confirmation Bill.

HOUSE OF COMMONS.

Thursday, June 24.

SOUTHWARK AND VAUXHALL WATER BILL.

On this Bill, which has been passed by the Select Committee to whom it was referred, coming up on a motion for its consideration,

Mr. STUART moved, as an amendment, that it be re-committed to the former Committee. He said the circumstances under which the measure now came before the House were these: For a number of years the quantity of water drawn by the Southwark and Vauxhall Water Company from the River Thames had been considerably in excess of that which they were legally entitled to take from that source; and the Thames Conservators had consequently applied for, and had obtained, an injunction to restrain the Company from continuing this illegal action. This injunction they had intimated they intended to enforce. The Company had accordingly brought in a Bill to authorize them to legalize their overdraft, in order that they might be enabled to supply the requirements of the poorer portion of the population of South London. The measure had been opposed on the ground that other Water Companies, if duly authorized by Parliament, were willing to supply the district in question with water. The London County Council were agreeable that a temporary measure should be passed which would authorize the Company to obtain the water from the Thames which would enable them to meet the demands of the locality for an efficient supply; but they thought the provisions of the Bill should be restricted to maintaining the *status quo* of the Company until the Royal Commission which had been appointed to inquire into the whole subject of the water supply of London had reported, and should not confer upon them any new powers of a permanent character. The measure, however, went further, and directed the Company to bring in another Bill next session, which would confer new permanent powers upon them. To this proposal the Council decidedly objected; and he now proposed that the Bill should be re-committed to the former Committee, in order that the objectionable clauses should be struck out, and the measure converted into a strictly temporary one—merely preserving the *status quo*, and regularizing the action of the Company until the Royal Commission should have reported. It had been suggested that the matter might be set right before the Committee of the House of Lords. But he was afraid that the case of the petitioners might be prejudiced by the action of the Committee of that House; and therefore it was he brought forward his motion.

Mr. BIGWOOD seconded the amendment, in order that justice might be done to Middlesex in this matter. In his view the Committee had adopted a high-handed method in dealing with the Bill, which should be made a temporary measure.

Mr. RANKIN, speaking as a member of the Committee before whom the Bill had come, thought there was but little difference between the Committee and the hon. member for Shoreditch (Mr. Stuart) with regard to the measure. The action of the Committee in passing the Bill in its present shape was due to the fact that, in consequence of the injunction against the Company having been obtained, it was necessary such a measure should be passed in order to prevent a water famine in the south of London. The Committee were desirous that the measure should be a temporary one only; and if the Bill were sent up to them again they would have no objection to amend it in that direction.

Sir J. PEASE thought that the measure should be a temporary one, and that no new permanent powers should be conferred upon the Company until the Royal Commission should have made their report.

Sir F. D. DIXON-HARTLAND stated the position of the Thames Conservancy in regard to the matter before the House. He said the Water Company already had parliamentary powers to take from the Thames 24½ million gallons of water daily; but for years they had been taking 40 million gallons daily. As Chairman of the Thames Conservancy, he was advised that it was his duty to go to the Courts to prevent a continued breach of an Act of Parliament. For years the Company had been doing nothing less than stealing the water, and selling it to their customers. He did not wish to put the matter too strongly, but it was so. An injunction against the Company was granted, to take effect at the end of twelve months; this interval being allowed for the Company to come to Parliament and legalize their action, and avoid risk of a water famine. In January next the Thames Conservancy would put the injunction in force. The principle upon which the Conservancy proceeded was this: There was ample water in the Thames for the whole of London; but the Companies must take it in a proper way in the winter months, and store it in reservoirs—not withdraw it in the summer, against the interests of navigation, when the water was low. If the House re-committed the Bill now, it would in all probability tend to the loss of the measure; and the House would then be responsible for the danger of a water famine next year.

Mr. SKEWES-COX said he had no wish to prevent the Company taking from the river the water they required; but he protested against the great waste from leakage, and the consequent damage to roads, in his constituency (Kingston Division). No undertaking had been given that the grievances of his constituents in this respect would be fairly considered.

Mr. BUXTON thought there would be little difficulty in coming to a general agreement. If a pledge were given that the interests of those who were now opposing the Bill would not be prejudiced at a future stage, he thought it might be allowed to pass; and to give practical effect to this he suggested that in Committee of the other House the promoters should withdraw the part of clause 4 which instructed them to introduce a Bill to take further water from the Thames.

Mr. STUART WORTLEY said the only desire of the Company was to legalize their position and to secure the power of supplying their customers, which was in the public interest. He could not at present say they were prepared to withdraw clause 4, because the question had not been put to him before, and there were others to be consulted. With regard to the remarks of the hon. member for the Kingston Division, he could assure him that the Company had no wish to deprive his constituents of any *locus standi* to which they were entitled.

Mr. CHAPLIN said they had been told that unless this question was settled on the present occasion, in a temporary manner at all events, the Thames Conservancy would put in force the injunction they had obtained. He, as President of the Local Government Board, dared not take the responsibility of an action which might contribute to a water famine in South London next summer; and if the question were pressed to a division, he should vote against it. This was purely a temporary Bill. Nothing was permanently fixed; and there would be every opportunity, as far as he could judge, for all parties being heard.

Mr. STUART said that, after the statements of the President of the Local Government Board and the Chairman of the Committee (Mr. Rankin), he would ask leave to withdraw his amendment, it being understood that this involved approval of nothing beyond the legalization for a limited time of what the Company were at present doing, and that the County Council's case would not be prejudiced in another place.

The amendment was then withdrawn, and the Bill was ordered to be read the third time.

The following further progress has been made with Bills:—

Bills read a second time and committed: Deal and Walmer Water Bill, Swansea Improvements and Tramways Bill.

Bills reported: Hunstanton Water and Gas Bill, Southwark and Vauxhall Water Bill.

Bills read the third time and passed: East London Water Bill, Lowestoft Water and Gas Bill, Weymouth Water Bill.

A petition against the Deal and Walmer Water Bill has been presented from the East Kent District Water Company.

HOUSE OF COMMONS COMMITTEE.

Monday, May 31.

(*Before Mr.* RANKIN, *Chairman, Mr.* RECKITT, *Mr.* S. SMITH, *and Mr.* NEWDIGATE.)

EAST LONDON WATER BILL.

This Bill, which is to authorize the East London Water Company to construct additional works and raise further capital by the issue of debenture stock, came before the above-named Committee to-day.

Mr. PEMBER, Q.C., and Mr. CLAUDE BAGGALLAY appeared for the Company. The other Counsel engaged were: Mr. LITTLER, Q.C., C.B., and Mr. RIGG, for the Corporation of London; Lord R. CECIL and Mr. S. MATTHEW, for the Middlesex County Council; Mr. BALFOUR BROWNE, Q.C., Mr. WORSLEY TAYLOR, Q.C., and Mr. FREEMAN, Q.C., for the London County Council; and Mr. BLENNERHASSETT, Q.C., for the Tottenham Urban District Council (who petitioned against alterations) and the Earl of Meath. Appearances were also reserved on behalf of a number of other interested parties, including the Essex and Hertfordshire County Councils.

Mr. PEMBER, in opening the case, said one of the principal ways in which the Royal Commission of 1892 reported that the present water supply in the Lea and Thames Valleys could be augmented was by providing more storage accommodation. The present Bill was quite in accordance with that recommendation, for it was to enable the East London Company to make two storage reservoirs adjacent to those they already possessed at Tottenham Marshes. They formed an instalment of the plan which was placed before the Commission by Mr. Bryan, the Company's Engineer, for increasing the storage in the Lea Valley. The present proposals were to provide reservoirs of 1015 million gallons capacity, which, with the existing reservoirs and those sanctioned under the Act of 1894, would give the Company a total storage of something like 2915 million gallons. After a brief reference to the subsidiary works, cuts to connect the reservoirs, certain small diversions, &c., provided for in the Bill, the learned Counsel passed on to speak of the general necessity there was for the works proposed. As a matter of fact, last year they had no such famine as visited the East-end in the previous year. That famine was due to the action of the County Council in opposing the Bill of 1893 for the construction of reservoirs which were sanctioned in 1894, and which, he was glad to say, would shortly be ready for use. But there was shortness of water; and for a time the Company had to discontinue the constant supply. The River Lea was most

unequal in its flow. In winter, enormous quantities of water came down it in flood, and were wasted; while in summer, the flow was reduced to the level of an ordinary tributary. It would therefore be to the interests alike of those who had to do with the river, of the Water Company, and of those who lived in their area of supply, that the Company should abstract at the time of the floods a quantity of water which could be stored in the proposed reservoirs against the time of need. The Engineer would tell them that even with these reservoirs the Company would still be a great deal nearer to want than it ought to be. The necessity for the works was further shown by the statement of the President of the Local Government Board in the House of Commons, that there was no escape from the conclusion that the famine in the East-end was caused by insufficient storage, and that this insufficiency was due to the County Council opposing the Company's Bill in 1893. There were one or two instructions moved in the House in reference to this Bill; the most important being the one obtained by Mr. Paulton, to the effect that, having regard to a resolution of the House on March 12, 1896, the Committee were to insert such provisions in the Bill as would ensure the acquisition by the Local Authority of such a suitable area for open space as in the judgment of the Committee could fairly be substituted for the common rights proposed to be extinguished under the Bill. As a matter of fact, the instruction was granted under a misconception, for no common rights were extinguished. Of the 200 acres which it was proposed to cover with water, 98 were what were known as Lammas lands. These lands were the property of private owners, and, as in the present case, were generally in a Manor. The private owners were, however, subject to certain servitude—viz., that certain freeholders in the Manor were entitled to pasture their cattle on the land except during the period of haytime, extending from April 5 to Aug. 12. The public had no right of recreation on these lands; and even if in theory they did possess a right to them, in practice they could hardly exercise it, owing to the difficulty of access and to their marshy condition. He contended that, being Lammas lands, they were not common lands, and that the public had no rights on them at all. To meet the instruction of the House, however, he had prepared a clause, though he did not think that it would be needed. But it might save litigation subsequently; and if the Committee thought fit, he would be prepared to accept it. If any clause were asked for to the effect that the Company should buy 98 acres of land and hand them or their value over to the local or any other authority to compensate for the public right in the 98 acres of Lammas lands, which he denied existed, the Company could not take the Bill; for even at a low estimate—say, £1000 an acre—it would mean an expenditure of £100,000. One or two other instructions had been threatened; but they had all been withdrawn, and he should not now trouble about them. Turning to the petitions, he dealt first with that of the Middlesex County Council, who had something to say about common lands and open spaces. The first point he had referred to; as to the second, he remarked that the Company did not intend to build on the land taken, and that it would remain just as much one of the "lungs of London" after the making of the reservoirs as before. The Council further said the Company proposed to extract water from places where the residents had a prior right to it. This had reference to clause 5, which when the Bill was first framed was much wider than it was at present. He thought this objection would fail now, seeing that in the filed Bill the Company only sought to deal with water they were already empowered to take. Clause 14 provided for the exchange of water between one Company and another; and to this the same petitioners took exception. He urged, however, that there was nothing in the objection; for it had often been contended that the present system of water supply in the Metropolis was bad, inasmuch as if the supply were all vested in one authority, the surplus of one district could be utilized to redress the deficiency in another. The London County Council alleged that the further appropriation of the water of the River Lea would be prejudicial to the interests of East London, and that the Bill was inconsistent with the recommendations of the Royal Commission. He should be amused to hear in what particular the Bill was against the report of the Commission. As to taking water from the River Lea, he repeated that all the Bill authorized was the taking of some of the water which flowed down in time of flood, and which could not be used for want of storage. The water of the river, moreover, was already parcelled out by statute between the Conservancy, the East London Company, and the New River Company. Subject to certain quantities for navigation purposes, the whole of it belonged to the two Companies, who were merely trying to conserve for the benefit of their consumers that to which they were already entitled. Then the London County Council said that, if the Company were to get additional supplies from the Lea, they should be placed under express statutory obligation to make payment for the use of such water. Payment to whom? The water already belonged to the Companies by statute; certainly it did not belong to the County Council. The Council further asked the Company to reduce their charges. This, he suggested, was a move, the object of which was to place the Company at a disadvantage when before an arbitrator in any purchase proceedings which might arise in the future. The Corporation of London, in their petition, alleged that the Company had failed to make sufficient and proper regulations to prevent the misuse of water. There was no doubt that no population approached that of East London in wasting water. The Company had recognized this fact, and had tried to obtain powers to check it; but on every occasion they had been met by the most uncompromising hostility on the part of the London County Council, with the result that their efforts had failed. The Company could not therefore be blamed on this score. In conclusion, he alluded to the sinking fund clause which was included in the Bill. The Company were of opinion that the clause should not be applied to the Company. But they had felt it would be useless to omit it; and so it appeared in the Bill. They held, however, that, as the reservoirs were only to safeguard the public against famine, and would not increase the income of the Company in the slightest degree, they should be treated in this matter no more severely than the New River Company, and that the operation of the clause should be postponed till the completion of the works.

Tuesday, June 1.

On the resumption of the proceedings to-day,

Mr. *W. B. Bryan*, M.Inst.C.E., the Company's Engineer, was called, and, in reply to Mr. Baggallay, said at the present time the Company had nine reservoirs; and another, making ten, would be finished in a few weeks. They were all at Walthamstow; and their total capacity was about 1200 million gallons, and their area about 320 acres. The works sanctioned in 1894 included not only two reservoirs, but the raising of the banks of the existing Racecourse reservoir; and the total increased capacity thus given was between 560 and 600 million gallons. If the Company had had these additional reservoirs in full use in 1896, they would have been able to cope with the drought of that year, and to give a constant and full supply at the time when it had to be stopped. At the end of this period of drought, the Company would have been in the position that he should not have deemed it expedient to draw down the last 150 million gallons, in view of any failure of the Thames supply. This supply came from Sunbury through a main 21 miles long; and any accident or failure in connection with it would have had to be met by the Walthamstow reservoirs. In the year of the drought, the quantity of water procurable from the Lea was very much less than it had been; and this had obliged the Company to correct their estimates as to the quantity that could be relied upon as available from the river in dry seasons. In July and August, 1896, following several dry years, the volume of water was smaller than they had ever known it before. The question of supplying the Company's district was now merely one of sufficient storage for the water that ran to waste. The demand was increasing very rapidly in the country districts of the Company in Essex. In the London district, save at Clapton, there was practically no growth of consumption. West Ham had very rapidly extended. In the middle of 1897, the Registrar-General's estimate of the population there was 273,682; while at the census of 1891 it was 204,903—an increase of 68,779. In East Ham, Leyton, and Walthamstow, the population was increasing in even greater ratio. The population in these places was about 200,000. In order to meet the increasing requirements of these country districts, it was advisable to construct new reservoirs. The scheme of the present Bill was to make two large reservoirs, which combined would have a capacity of 1015 million gallons. The area of the water would be about 205 acres. The two reservoirs would be on the same level, but higher than those they would adjoin. They would involve the making of certain works. No. 1 cut would bring the water from the Company's existing intake into the new reservoirs; No. 2 was a diversion of the Ching Brook; No. 3 was a diversion of the River Lea itself; and No. 4 was a small cut necessitated by No. 3. Then there were two conduits merely providing communication between the present and the proposed works. The two reservoirs were separated by what was at present a footpath running across the marshes. They did not propose to take any further powers of abstracting water; in fact, the scheme was to ensure against difficulties arising out of exceptional periods of drought, and in anticipation of the greatly increasing population in the district. It was another instalment of the scheme which he, on behalf of the Company, laid before the Royal Commission in 1892, and which was approved by them. The estimated cost of the reservoirs and cuts was £342,000. It was also proposed to lay a new main in connection with the supply obtained from the Thames, and to give a higher pressure, the cost of which would be £48,000. Then, to meet the normal growth of the district, an addition to machinery was required, costing some £40,000. For the extension of existing mains and services, the Company sought power to raise £20,000 a year for three years. This with a similar sum derived yearly, under the Act of 1894, for seven years, of which three were unexpired, would give them £20,000 a year for the next six years. The total capital asked for was £500,000. With regard to the Lammas lands taken, he said the whole of the ground was low-lying—being only some 12 or 18 inches above the level of the river—the consequence of which was that it was always subject to floods. Since last November, the land had very frequently been under water. It was very inaccessible; and though he frequently passed near it, he had never seen people using it for recreation purposes. Cattle pastured over the land.

Cross-examined by Mr. Blennerhassett: There were 98 acres of Lammas lands included in the limits of deviation. He was aware that the Hackney Marshes, even at the time when they were liable to flooding, were extensively used for recreation purposes; but this was because there were good means of access, and the floods lasted only a very short time. It was true that before the Royal Commission he said there were many places in the Lea Valley well adapted for the construction of large storage reservoirs; and he referred to sites of 90 and 100 acres, and other sites higher up the valley.

Mr. Blennerhassett: That being the case, could you not obtain your reservoirs on other sites without interfering with the Lammas lands?

Witness: In the first place, the new reservoirs have been constructed on the 90 acres of land referred to. The other 100 acres are taken for the reservoirs in the present scheme.

You also said there were other excellent sites farther up the valley. Has anything happened to interfere with those sites?—Nothing.

Therefore you might have gone to those sites instead of taking these Lammas lands?—Yes; and if we went, we should have to take other Lammas lands there. The absorption of Lammas lands on the present site would do far less injury than higher up.

In answer to Mr. Worsley Taylor, witness said the present storage capacity of the reservoirs was 740 million gallons, of which only 600 millions were actually available. With the works now in hand, the storage would be increased to 1200 million gallons; and with the works proposed, it would be further increased to 2215 millions. Clause 14 of the Bill gave facilities for the use by one Water Company of the works of another, and for the inter-sale of water in case of need. He considered this a most valuable thing for the public. It had been urged by the County Council that if the different water-works had been in the hands of one authority there would have been very little difficulty with the drought that occurred in East London. This being so, he thought it his duty to recommend the insertion of the clause. The East London Company had already obliged the Grand Junction Company with the use of their 36-inch Thames main. The clause would merely enable the resources of any district which could be connected to be used for the benefit of another in case of emergency. Their Thames main, for instance, would put them in connection with the New River, the Grand Junction, and the Southwark and Vauxhall Companies. He did not know that under the Staines Reservoirs Act of 1896 the water granted was only to be used by the three Companies mentioned in the Act.

Mr. Worsley Taylor: When you are expressly providing that the Grand Junction and the New River Companies—two of the Companies referred to—may sell water to you, you are empowering them to do that which was forbidden by the Act of last year.

Witness: My opinion may be wrong, but I do not think that is so. On the other hand, the Grand Junction, New River, and Southwark and Vauxhall Companies have large quantities of water which are not governed by the Act of last year. Why should they be prevented from helping us, or we from helping them?

In further cross-examination, witness said if the New River Company were drawing to the full from all their other resources than that authorized under the Staines Reservoirs Act, he agreed that if that Company were to sell water to the East London Company it might involve the New River Company drawing from the Thames under the Act at a time when they would not otherwise do so. The effect of the clause might be that one Company could sell to another at a profit. In theory this might add to the value of the selling Company's undertaking; but he denied that it would do so in practice. The clause might also enable the Company buying the water to increase their dividend, and thus raise the price which would have to be paid for the concern in case of purchase. When he put in the clause, he had no idea of making profit. He simply inserted it in the interest of the consumers; he had nothing to do with the financial side of the question. He agreed that this was one question the Royal Commission were appointed to inquire into.

By Mr. Rigg: The 1200 million gallons would give the East London Company 60 days' supply on the basis of 20 million gallons a day. The average consumption throughout the year would be from 40 to 43 million gallons. They obtained about 10 millions a day from the Thames, from 6 to 8 millions from their wells, and a further quantity from the Lea, which quantity would be the surplus above the dry-weather flow. All beyond this would be taken from storage. The dry-weather flow of the Lea had considerably decreased; and in August last it was only about 14 million gallons a day. The droughts had on several occasions lasted considerably longer than 60 days. The reservoirs would take seven years to complete. The main referred to in the Bill would be a branch from the existing Thames main, and would run from it at Islington to Whitechapel. At present the water from the Thames was conveyed to a reservoir at Finsbury Park. Whitechapel was a long way from Finsbury Park; and the effect of the new main would be to save distance, and lessen the friction of the water passing through the pipe, and thus give about 25 feet extra head to the water.

By Mr. Matthew: There was not the slightest objection to making a roadway where the present path dividing the reservoirs existed, and the embankment had been planned to allow the road to be 40 feet wide. The Company did not propose by the Bill to sink any wells, as they possessed this power under their Act of 1886. It would not be possible to devote to the sinking of wells a portion of the capital they desired to raise, as it was all allocated. He agreed that £500,000 was to be raised, of which only £490,000 was definitely allocated. The surplus, as well as any surplus on the other works, could be used for any of the purposes to which capital was ordinarily applied. The whole of the flow of the River Lea, except what was required for navigation purposes, would be divided between the New River and East London Companies.

Mr. R. A. Read, for the Hertfordshire County Council, said he should have a clause to bring up later, making it clear that the capital could only be applied to the purposes for which it was granted, and that none of it could be devoted to sinking additional wells.

Re-examined by Mr. Baggallay: The effect of the filtration of the water was tested from time to time by analytical examination. The Company had 31 acres of filter-beds. They would certainly not take in the first of any flood water, because it would contain the scouring of the ditches and subsidiary water courses, and might lead to unduly dirtying the filter-beds, and show badly on analysis. The relative priorities of those entitled to take water from the Lea were prescribed by the Act of 1855, and had not been altered since. About three-fifths of the population supplied were in the County of London, and about two-fifths in Essex. As to clause 14, he said that if another Water Company made a profit by selling water to the East London Company in time of need, the latter would incur the cost of purchasing the water; and as the dividend and value of one went up, those of the other would go down. He only wished the clause to be operative in cases of breakdown of machinery, bursting of trunk mains, or times of drought—in times of emergency in fact. This power was exercised in 1895 and 1896; and but for it the public would have suffered very much more than they did. The Company had had pressure put upon them by the Local Government Board, through Major-General Scott, the Water Examiner, to make provision for interchange with other Companies. Interviews had taken place with the Secretary of the Company and himself in 1895 and 1896, suggesting that they should get help from the New River or any other Company with whom they could arrange. There were difficulties as regards connections with the other Companies; but the New River Company agreed to allow about 4 million gallons a day to flow down the River Lea to the East London Company's intake. He believed it had always been an argument of the London County Council that, if the works were in the hands of one body, great advantage would result. This was one of the points referred to the Royal Commission.

Sir *F. Bramwell*, F.R.S., examined by Mr. Baggallay, said he had considered for a long time the question of Metropolitan Water Supply, and had been concerned in a great many schemes for increasing the reservoir capacity of the works. He was aware of the enormous development that was taking place in East London. He had considered the present scheme, and it appeared to him to be following out entirely the recommendations of the Royal Commission. The reasons for it were obvious. In the first place, the Company wanted storage for subsidence; and in the next, they desired to take in the water of the river which was now running idly away, in order that they might not have to draw it when the river ran low. It was the best thing he knew for the river and for the population to be supplied. Under the scheme the minimum flow would in no way be affected. Mr. Bryan's estimate of seven years for the completion of the works was not excessive. It would not be safe to go on without commencing these works. The proposal to couple up the mains of the Company with those of other Water Companies, so as to supply one another with water, was one which had been repeatedly urged in other cases. Leaving finance out of the question, he could not understand anyone advocating that the Companies should be under one authority, and objecting, in the interest of the consumers to this power of exchange. As to the sinking fund, if it was to be imposed—and he presumed it was—it seemed to him that the payment of the fine should be deferred till some time after the works were in use.

In cross-examination by Mr. Balfour Browne, witness said he understood the interchange clause was intended mainly to meet emergencies; and the judges of the emergency would be the people who had to supply the water. He should leave the matter to their discretion. He had not considered financial questions.

Mr. Balfour Browne: Then I will argue that afterwards.

Mr. *G. H. Hill*, M.Inst.C.E., in reply to Mr. Baggallay, said he was a member of the Royal Commission which considered the Metropolitan Water Supply in 1892 and 1893; but he was not now representing the Commission. He knew what the Company's suggestions were, and had been over the sites of the two proposed reservoirs. He thought the scheme for increasing the storage was in accordance with the plan that was always followed in connection with surface water. The present was a proper time to proceed with the works proposed, which were only part of a larger scheme. There should be no delay in the construction of the reservoirs, having regard to the present and probable increase of population, and to the experience of recent droughts.

Cross-examined by Mr. Balfour Browne: He was in favour, as a rule, of the water supply being in public hands if possible; if not, the public interests should be safeguarded.

Mr. *Charles Hawksley*, M.Inst.C.E., agreed as to the necessity for the proposed works.

Mr. *J. W. Couchman*, agent to Sir W. M. Curtis, gave evidence with regard to the Lammas lands which form part of the site of the proposed reservoirs. He said that certainly no part of the land was subject to use by the public for recreative purposes; nor could it be used for such purposes because of its marshy character and its inaccessibility. The land was different from common land, and the public exercised no common rights over it.

Several other witnesses were called in reference to the Lammas lands; their evidence being to the effect that the general public had no common rights over them, that they were unsuitable for recreation, and had not been used for such purposes, and that only the section of the public who had a direct right of feeding cattle there, or of taking one crop of hay at a certain period of the year, were interested in them.

This closed the case for the promoters.

(*To be continued.*)

HOUSE OF COMMONS COMMITTEE.

Tuesday, May 11.

(*Before Colonel* Gunter, *Chairman*, *Mr.* J. A. Pease, *Mr.* A. Brassey, *and Sir* Weetman Pearson; *Mr.* Bonham-Carter, *Referee.*)

ST. NEOTS WATER BILL.

This Bill, the object of which was to incorporate a Company for the construction of works and the supply of water within the parishes of St. Neots and Eynesbury, in Huntingdonshire, and to repeal the powers granted to the East Huntingdonshire Water Company with regard to the supply of water within the prescribed limits, came before the above-named Committee to-day.

Mr. Balfour Browne, Q.C., Mr. Wedderburn, and Mr. A. Willes appeared for the promoters; Mr. J. D. Fitzgerald, Q.C., and Mr. Rigg, represented the St. Neots Urban District Council, who petitioned against the Bill.

Mr. Balfour Browne, in opening the proceedings, said that St. Neots had a population of between 4000 and 5000; and such a number of inhabitants worse off for a water supply he did not think could be found in any place in England. The report of their own Medical Officer of Health he thought would be absolutely sufficient to pass the Bill. The present water supply was obtained from wells sunk in the gravel, into which the whole of the sewage of the town was poured; so that there was infiltration from the sewage into the wells, and a state of things which ought not to exist for a single day. The District Council resolved that by the 8th of February last year—according to the Medical Officer's report for 1895—the old midden-privies should be replaced by the pail system. Difficulty was experienced in carrying out this resolution. Opposition was offered to it in many quarters; the people of St. Neots being rather benighted. But the Medical Officer had urged on the Local Authority the necessity of removing the "defective and detestable privy-midden system," which the Local Government Board, in their official memorandum of 1894, had described as a "source of nuisance of the gravest kind, which cannot fail to be injurious to health." The Medical Officer drew attention to this matter in his report for 1886, in which he said: "The provision made for excremental matter is by privy-middens and cesspools. A few of these, belonging to better houses, are constructed so as to be water-tight, or nearly so, and are provided with overflow-pipes to the main drain. The majority, however, are built of brick uncemented, and are not water-tight; merely retaining the solid fæcal matter, and leaving the liquid sewage to percolate freely into the soil. There being no bye-laws to compel the regular emptying of these privy-middens and cesspools, or the adoption of the pail system, they often remain for long intervals without being cleansed, save at the request, or by the action, of the occupiers. Of a total of 984 houses, only 142 have water-closets; and of these, many possess no proper or adequate arrangements for flushing. Now, with regard to the removal of these evils, what I would advise is as follows: (1) The removal of privy pits, middens, and cesspools, and the adoption in their places of excreta pails, as provided by the Board, which will permit the frequent removal of contents, and will entirely prevent the soakage of liquid sewage into the subsoil. (2) The removal of all large ashpits; small ones, properly covered, and provided with flap-doors and a ventilating shaft, to be erected in their place. (3) Provision by the Local Board for the frequent, compulsory, periodical emptying at intervals—never exceeding one week—of privies and ashpits, and the

removal of all refuse close to dwellings. There are, of course, certain difficulties in the carrying out of the resolution which I am discussing; for there is no doubt that all midden-privies, whether old or new, are dangerous to public health, and they are all comprised within it. I believe, however, that with tact and discretion, its provisions may be enforced without friction, and without unfairness or hardship to anyone." This was the condition of things in 1886; and practically it was the same now. With regard to the water supply, the Medical Officer said in his 1895 report that this question remained in the position in which it was formerly, notwithstanding that the Local Government Board (whose Inspector had visited the district in 1894) had expressed regret that the District Council had not "decided to provide a supply of water from a source that was above suspicion, in place of the present unsatisfactory supplies." The Medical Officer entirely endorsed this regret; and he again referred to his 1886 report, in which he had said: "With regard to water, the present supply is entirely afforded from private wells sunk in the gravel. In the southern part of the town, it appears that there is an intermediate stratum of clay; and the wells there may, possibly, yield better water than those in the other parts. The vast majority, however, being in gravel only, and of no great depth, are necessarily contaminated with anything that percolates into the subsoil, and pollutes it. Owing to the privy-middens and cesspools existing here, and the proximity of them to the wells, the physical conditions surrounding these wells are such that pollution of all, or nearly all of them, is inevitable. In New Street, Russell Row, Huntingdon Street, Eynesbury, and elsewhere, the wells and cesspools are often close together; and all liquid sewage sinks almost directly into the subsoil, whence the water is drawn. I am astonished that typhoid fever is ever long absent while such a state of things continues. It is true that, by forbidding the use of well water, the principal existing cause of some diseases—such as typhoid fever, *et hoc genus omne*—would be removed. Still, the continued soaking of the subsoil with liquid sewage, in the midst of the population, is highly injurious in other ways—viz., by the vapours and sewer gases escaping at certain times, such as when excavations are made, when the weather is very hot, and when the subsoil or ground water is rising. It is, in my opinion, impossible to over-estimate the incalculable value of a sufficient supply of wholesome drinking water for the town. I am fully aware that, in the opinion of a certain section of the population of St. Neots, a water supply is not needed. And it is also agreed that our low death-rate, and the absence during a length of years of any serious epidemic of infectious disease in the town, is sufficient proof that the water supply is all that is required. This argument is utterly fallacious; and it is based on illogical premisses. The real question at issue is neither our death-rate nor our immunity from zymotic disease; it is whether the water is, or is not, contaminated with sewage matter. That it is so is entirely beyond dispute; and in the face of this fact, we are constantly in the presence, and within a measurable distance, of a great and threatening danger that may at any moment come upon us with the most disastrous results. I am confident that, were this town to become the site of dangerous infectious disease—such as typhoid fever, cholera, or diphtheria—the water supply, as it now is, would play an important and most fatal part in the propagation and development of such an epidemic, and to an extent that it is terrible to contemplate. It is blind folly to ignore facts that are practically and positively beyond dispute, and quietly wait, in fancied security, until, in a moment, we stand convicted of wilful neglect and procrastination, and are compelled to acknowledge that we are, alas! too late, and impotent to avert the evil that has overtaken us and the public, to whom we are responsible, by our deliberate inaction and supineness—and this in the face of facts that were patent to all." That was a quotation from 1886. What did he go on to say in 1896? "This state of affairs—as existing ten years since—is precisely the same as at present; and I would once more ask you to endeavour to realize the necessity of taking some prompt action so as to secure a pure supply of drinking water for your district." He (Mr. Balfour Browne) considered nothing could possibly be more eloquent than this of the absolute necessity of doing something, and doing it at once. But this Local Authority had refused to do anything. Under these circumstances, the matter had been taken up by certain gentlemen who were interested in the town; and a supply of water was proposed to be given from a source which was absolutely unexceptional—from a shallow well in the gravel at a spot 66 yards from the River Ouse, and from a deep well about 400 yards from the river. It was proposed to acquire a quantity of land, in order to prevent the possibility of any manuring going on over the sites of the wells. It would be shown by the analyses of the County Medical Analyst (Dr. Thresh) that the water which would be supplied would be of excellent quality. Neighbouring towns, such as Huntingdon and Bedford, were also getting their water from the gravel bed. The only opposition to the Bill was that of the Local Authority, who, he did not hesitate to say, had grossly neglected their duty, and had also garbled this Bill in their communications to the Local Government Board. The Urban Council at first seemed in favour of the Bill, though when the Parliamentary Agent to the promoters went down to the locality and saw them, they declared that they were not themselves prepared to take the scheme in hand, and that if a local Company were started it would get no support at all. The only other course was for the supply to be given by an outside agency. The Urban Council had appeared desirous of securing amendments in the Bill, and had suggested several; the promoters complying in almost every respect with the resolutions they had passed on the subject. The only one they did not agree to had reference to rates. The Urban Council had made a proposal as to a prospective purchase of the undertaking; and this clearly contemplated the passing of the Bill. The resolution of the petitioners on the subject of rates was as follows: "That the proposed maximum rate of payment for water for domestic purposes fixed by section 35 of the Bill should be so altered that the rates should not exceed 6s., instead of 8s. 8d. per annum, and so on in proportion for any shorter period, in respect of any dwelling-house or part of a dwelling-house of which the annual rateable value does not exceed £7; and that in respect of any dwelling-house of which the annual rateable value does not exceed £20, the maximum charge should be at a rate not exceeding 7½ per cent, instead of 10 per cent., upon the annual rateable value of such dwelling-house or a part of a dwelling-house." This was the matter upon which they split; and he should bring evidence before the Committee in support of the contention of the promoters. This was his reply: "The promoters will agree to the following modification of rates—2d. a week below £5; 3d. a week below £7 10s.; 4d. a week below £10; 10 per cent. between £10 and £20; 9 per cent. between £20 and £40; and 7½ per cent. above £40. The supply of water to small property is not profitable; and the district is too limited to allow of much reduction." He admitted that, on the question of rates, there was no agreement between the promoters and the petitioners. The promoters had tried to meet them on this point, and had failed; and he would ask the Committee to limit the petitioners to that. The petitioners were now seeking to get a number of things which they had never brought into question before. The learned Counsel then dealt with the petition clause by clause, and pointed out that the whole capital required for the Bill was £5000. He protested against the petitioners, evidently at the instigation of their Engineer, now coming to Parliament and suggesting that they should be permitted another year to obtain powers to supply the district with water. He submitted that it would be a breach of faith to allow the petitioners to go beyond their resolutions—to go, in fact, beyond the question of rates.

Mr. *Thomas Codrington*, M.Inst.C.E., was then called and examined by Mr. WEDDERBURN. He said he had been for 13½ years an Engineering Inspector of the Local Government Board. He had inspected the district which it was proposed to supply with water under this Bill. Having explained the present supply by means of shallow wells, and declared it amply deserving of the condemnation of the Medical Officer of Health, he described the works which it was proposed to construct. Many towns were supplied with water by similar means—that was to say, by water pumped from the gravel. London obtained a large part of its supply by this means. So far as St. Neots was concerned, this was the only practicable water supply. He did not think they would be able to get water satisfactorily from the greensand formation, as the available source would be some seven miles away. It was proposed to construct a reservoir, the height of which would be 137 feet, which would give sufficient pressure for all the houses in the district. The rates which it was proposed to charge under the Bill were reasonable.

Cross-examined by Mr. FITZGERALD, witness said that when he referred to the promoters of the Bill he meant Mr. Baker, the Parliamentary Agent. He could not give any information as to who was supplying the money for the Bill. He admitted that the place at which it was proposed to sink wells was sometimes flooded by the river, the water of which received the sewage of several towns and villages. The flood-water, however, would never be allowed to get into the wells. No doubt water would be drawn into the well near the river; but the promoters could filter it whenever it was necessary. As he understood it, the well near the river was to be abandoned.

Mr. WEDDERBURN said that it was proposed to make two wells; but both of them would be far outside the flood-level.

Mr. FITZGERALD: You are familiar, as Inspector, with the provisions of the Public Health Act?

Witness: Yes.

And you know that the duty of supplying water is cast by Parliament upon the local authority?—Yes.

And have you ever known a case in your experience where, the local authority having announced their intention of getting a water supply for themselves, Parliament has allowed a company to intervene?—I cannot remember one at this moment; but I believe there are such cases.

If there are such instances, I should like to hear of them?—I cannot remember them.

Mr. FITZGERALD: In another room this session, witness after witness was challenged to produce such a case, and failed; and the Bill was thrown out in consequence.

Mr. WEDDERBURN: There the Committee left the water supply in the hands of a private company. I was going to quote the case to the Committee.

In further cross-examination, witness said that the result of passing the Bill, even if the Company did nothing at all, would be that the hands of the Local Authority would be tied for five years. During this period the town would only have the surface shallow wells, if the money required was not raised. He did not know that the Urban District Council of St. Neots had unanimously passed a resolution that, if the Bill was rejected, they would take the necessary steps at once to get a proper supply of pure water for the district.

In reply to Mr. BONHAM-CARTER, witness said that the amount of water which would have to be taken from the gravel under the Bill would be 100,000 gallons a day.

Mr. *Thomas Hennell*, M.Inst.C.E., said he had been consulted by the St. Neots Authority on several occasions; but nothing had ever been done. He did not think there would be any difficulty in obtaining the supply of water required under the Bill. He had no doubt that this supply would eventually be adopted, whoever did the work.

In cross-examination, witness said that the cost of the works was estimated at £5000 to £6000; but the amount in the Bill was £15,000.

Mr. *Percy Griffith*, M.Inst.C.E., M.Inst.M.E., corroborated the evidence of the previous witnesses. He added that, as this was a small town, the rates would be higher than in a large place. Those proposed were, in his opinion, fair and reasonable.

Mr. *Baldwin Latham*, M.Inst.C.E., also gave evidence in support of the Bill. He stated that the greensand formation had never been successfully used as a source of water supply.

Mr. *J. P. Maule*, Deputy and Acting Town Clerk for Huntingdon, and Clerk to the Huntingdonshire County Council, described the Huntingdon Water-Works. He stated that the pumping-station was a little above the flood-level. The water was very good, and only slight complaints were made of its being a trifle cloudy at the time of very high floods. The health of Huntingdon was good; the death-rate being very low.

Mr. WEDDERBURN: Can you give the Committee any information with regard to the present supply in St. Neots?

Witness: Yes; I can tell them that, with regard to property over which I have control situate in the Market Place at St. Neots, a complaint reached me only yesterday morning as to the condition of the water, which had been analyzed by the Medical Officer of Health for the district. The report is that it is nothing but sewage water. The water was from a well. We advocate this scheme so far as we are personally concerned—that is to say, we want a supply of water. We do not care at all who brings it. The Bill has been submitted to the Parliamentary

Committee of Huntingdonshire County Council, who passed the following resolution: "Resolved, that this Committee regret that, from the reports received, the condition of the water supply at St. Neots and Eynesbury is unsatisfactory, and therefore offer no opposition to the Bill."

In cross-examination, witness said he thought it a desirable thing that in a small town the water supply should be in the hands of the Urban District Council, as was the case in Huntingdon. The County Council were of the same opinion; but in this case the Local Authority had been so tardy, it was desirable somebody else should move in the matter.

In re-examination, witness said that personally he had no confidence in the St. Neots Local Authority being energetic in the matter of the water supply.

Wednesday, May 12.

Mr. *G. Bower*, a resident in St. Neots for half a century, examined by Mr. WEDDERBURN, said that from 1876 to 1887 he was Chairman of the St. Neots Local Board. He had, as early as 1876, realized the necessity of having a good water supply, and had urged the Board to secure it.

Mr. WEDDERBURN: Was there anybody who supported your advocacy of the need of a good water supply?

Witness: No; the members of the Local Board were content with the death-rate being low, and afraid of the water-rates being high.

In reply to further questions, witness said he had some years ago tested the gravel formation in the valley, and had found any amount of water. He had come to the conclusion that, with five acres of land and half a dozen Abyssinian tubes, he would get water sufficient to supply the 4000 people of St. Neots twice over. So far as he was aware, however, no practical steps had been taken during the past twenty years to obtain a good supply of water beyond the agreement entered into with the East Huntingdon Water Company, which had come to nothing. He had attended a public meeting at St. Neots called to consider this Bill; and he had there stated that it was better to have what one might call an outside Company than to have no water supply at all. The conditions upon which he would allow an outside Company to come in, would be that they should supply the district in bulk, and allow them to distribute it themselves.

Cross-examined by Mr. FITZGERALD, witness said he knew, as a resident in St. Neots, that the Medical Officer to the District Council had reported that the present scheme was to be viewed, on sanitary grounds, with the gravest suspicion. That was not witness's opinion. It was true the death-rate at St. Neots was very low, and that the town was singularly free from zymotic disease. It was true that the District Council had passed a resolution binding themselves, if this Bill were rejected, to bring forward a scheme for a supply of water. He had written a memorandum to a local paper in which he stated that it would be much more economical for the town to construct the water-works themselves. He trusted that if the preamble of the Bill was passed, the Committee would insert clauses in it requiring the Company to sell water in bulk to the Local Authority. This was the arrangement he had made with the East Huntingdon Company—to supply the water at 6d. per 1000 gallons.

Re-examined by Mr. WEDDERBURN, witness said that in clause 41 of the Bill arrangements were provided for the supply of water in bulk to the Local Authority. He was satisfied with the financial scheme of the promoters; but he thought the charges proposed were too high.

In reply to a member of the Committee, witness said the East Huntingdon Company had not carried out the arrangement which had been proposed for two reasons—first, because they had bad water; and, secondly, because they had not sufficient money. He still thought that 6d. per 1000 gallons would be a fair price to pay for the water in bulk. He could not quote any instance where an attempt had been made by a company to supply at that price under like conditions; but he had no doubt that the Company would be able to supply water at the price he had named. He believed the feeling in St. Neots now was that it would be advisable for strangers to come in and bring their capital and supply the place with water, providing they could have the distribution of it themselves. The District Council had a plan of their own; but he believed it would cost twice as much as the other.

By the CHAIRMAN: He thought £7000 would be ample to carry out the scheme of the Bill. He would suggest that the time for option of purchase should be within five years.

Mr. WEDDERBURN said he now proposed to call evidence with regard to finance. The quality of the water had not been attacked; but if it were thought necessary, he would call a chemist.

Mr. *John Redmayne* stated that he was a stockbroker; and that when he was asked to consider the question of the financial prospects of this undertaking, he had tried to discover a parallel water scheme. He found that the Shelf Water Company was a small undertaking, with a capital of £3000; the Shepton Mallet Water Company, with £5200; the Sleaford Water Company, with £6000; and the Wells Water Company, with £5000. These Companies were all paying concerns. He was prepared to place the matter before his clients, assuming that the works could be carried out at the cost proposed, and that they were managed with moderate economy.

In cross-examination, witness denied that he had made terms with anybody for underwriting this undertaking. He believed the idea was that the works would cost £7000 or £7500. The promoters asked for a capital of £12,000, with power to borrow £3000. He was not aware that they had incorporated the Companies Clauses Act, so that they could turn the borrowed capital into shares.

By Sir W. PEARSON: He should put this Company before his clients as a water-works concern which he was satisfied, if the work went on and was well done, might become a steady good paying business, realizing a dividend of from 5 to 8 per cent.

Mr. *E. O. Preston*, a financier and mortgage broker of London, stated that his firm had provided loans to local authorities, corporations, companies, and so on. He had looked into the present scheme; and from a financial point of view, he regarded it so favourably that he should be prepared to find the whole of the necessary capital, on reasonable terms. He was aware that the dividends would be limited to 10 per cent.

Mr. *T. Addyman* said he was one of the first proposed Directors of the Company. There would be no difficulty in carrying out the works for about £7000. He should be prepared to put some of his own money into the concern.

By the CHAIRMAN: His opinion of the scheme was certainly favourable.

Mr. *W. Whitaker*, F.R.S., stated that in the district whence it was proposed to take water under the present scheme, the water from the gravel area would be the best.

Dr. *J. C. Thresh*, said he knew the district dealt with in the Bill, and thought it would be impracticable, on account of distance, to get water from the greensand, though water taken from there, as a rule, was of good quality. He had analyzed two samples of the water which it was proposed to take, and had found that it would be perfectly safe for the use of the community. It was only right to say that it contained a certain amount of nitrates, which were due to the oxidation of the manurial matters placed upon the fields; but they could not in these districts get water without such matters. It was innocuous in itself; and this was a proof that all the organic matter on the surface of the ground had become oxidized and was innocuous.

By the CHAIRMAN: It was a good pure water for general use. In Essex, many villages and towns were using similar water. In hardness it was very much like London water.

This concluded the case for the promoters, and evidence was called for the petitioners.

Mr. *George Flawn*, Chairman of the St. Neots Urban District Council, examined by Mr. RIGG, said that his Board had many times prospected for water. They had had holes dug in the gravel on the town common and at Green End. Mr. M'Nish had also prospected; and the water had been found very unsatisfactory as to quantity and quality. Witness went on to explain the measures which had been taken to prevent impurities from contaminating the well water of the town. The Council were very anxious now to do the best they could to obtain a proper supply. They had expressed disapproval of the site of the proposed supply, and contended that there ought to be some system of filtration. The Company practically declined to accede to anything which the Council asked. At the meeting of ratepayers, not a single hand was held up against the proposal to oppose the Bill.

Cross-examined by Mr. WEDDERBURN, witness said he was not an expert in the matter of water supply. He was a property owner at St. Neots and at Eaton Socon; but he denied that his opposition to the present scheme was in view of the possibility of the establishment of a water-rate. He also denied that Mr. Bower was right when he said that the Urban District Council, by their conduct, invited the new Company to St. Neots. He considered that there was great danger under the proposed scheme of sewage flowing into the new reservoir from the land where the sewage was now disposed of. It must go down the river. He did not say that the water contaminated with sewage would flow directly in over the land, but it would come by percolation.

By Mr. BONHAM-CARTER: The Council had been seriously considering the question of water supply for the last two years; but no practical steps had been taken until quite recently.

Mr. *J. M'Nish*, for many years Chairman of the Local Board, and at one time Chairman of the District Council, said he had been in favour of the East Huntingdon scheme; but this had failed. The brewers he was connected with had endeavoured to pierce the clay in St. Neots for water; but this attempt had been unsuccessful. That was on the same bed of gravel on which the proposed site was situated. He considered that the proposed site was not a good one, in view of the conditions under which the Company proposed to supply the water. It was subject to floods; and the water taken from it could not be considered safe unless it were filtered. It would be to the advantage of the inhabitants of St. Neots that the matter of the water supply should be deferred for another year, to enable the Local Authority to act,

In cross-examination, witness said he knew a gentleman named Jordan, who had to cart his water about 1¾ miles. He paid £10 a year for the water; and it cost him £60 a year to cart it. He knew there was a provision in the Bill that would enable the Local Authority to purchase their water. He should almost be converted to the scheme, if the promoters would guarantee good water at 6d. per 1000 gallons. Of course, the source of supply would have to be safe.

Re-examined, witness said the promoters ought to go farther afield to secure a water supply. There were three possible sources—one was the gravel bed and the river combined, another was to try and pierce through the Oxford clay, and the third would be to go into the greensand at Tetworth. He had exhausted all the water in his own wells, and in those of his neighbours adjoining, in the gravel in about two hours, by the use of a steam-pump. The flood-water was turbid in the lower as well as the upper gravel.

The CHAIRMAN: Do you use the river water for brewing?

Witness: We do partially. Our main supply is spring water; but we draw from the river. We have a perfect system of filtration, which we put down at considerable expense. The water is then carried into the brewery and boiled for about half an hour, after which it is treated. I am not at liberty to tell you how it is treated.

Thursday, May 13.

Mr. *John Birds*, Inspector of the Board of Agriculture, residing at Brampton, Huntingdonshire, examined by Mr. FITZGERALD, said he had had considerable experience in questions of water supply and the sinking of wells. He had been some years agent for an estate at Hatley, belonging to the late Mr. Evans. Two wells had been sunk on that estate for the purpose of obtaining a supply of water. They were some 170 feet in depth, and 4 feet in diameter. At the bottom of the wells, there was a 3-inch boring 12 feet deep. There was a head of water in the wells of 28 feet; and steam-pumps were used. When the first well was finished, they tested it by pumping six days and nights continuously; and at the end of this time, the water was in no way exhausted. They filled a lake on Mr. Evans's property, and did not diminish the depth of water in the well. This water was coming from the greensand, and was found on analysis to be of good quality. The first well was dug in 1877; and the second in 1893. He had no doubt that one of these wells would supply St. Neots. As for the water it was proposed to distribute under this Bill, he would not drink it; and there was no reason why the inhabitants of St. Neots should be forced to do so.

In cross-examination, witness said he did not know that the wells he had described were not far from the East Huntingdon Company, who, wanting a pumping supply, had found that they had been unable to

obtain good water. This Company, in going into the greensand, went through a bed of ironstone, which was prejudicial to the supply. It was a mystery, however, why they had not got a sufficient quantity. The point at which the East Huntingdon Company took their water was ten miles from St. Neots; and this, at £800 a mile, would mean an extra expenditure to St. Neots of £8000.

By Sir W. PEARSON: The East Huntingdon Company went to Hertfordshire for water, after studying his source of supply.

Mr. *J. W. Knights*, an analytical chemist, said he had examined some 500 or 600 samples of water from the greensand taken at Hatley and Tetworth; and he invariably found it unpolluted, and quite fit for drinking purposes.

In cross-examination, witness said his experience was that of all waters those from the gravel were most likely to be polluted, and, therefore, most in need of filtration.

Mr. *T. Poyntz-Wright*, Medical Officer of Health to the St. Neots Urban District Council, proved his report on the water supply of the town. He had stated that the proposal to take water from a site near the river which was liable to sewage contamination, should be viewed with the extremest caution and the gravest suspicion, save and except where there was a perfect system of filtration established. At the time of writing the report, the site was two feet under water from flooding of the river. If any pumping-station had existed at the spot during the great flood of 1894, the site would have been six feet under water, and the station would have been washed bodily away. After reading his report, the District Council had determined upon opposing the present Bill. Some of the water would come by percolation from the Ouse, which was constantly polluted with sewage matter. He did not see why a good supply of water should not be obtained from the greensand.

Cross-examined: The experience of the East Huntingdon Company, who got their water from the greensand, was not encouraging. The need for a good supply of water to St. Neots was very urgent.

By the CHAIRMAN: He had analyzed Ouse water, and found that it always contained an amount of organic matter.

Mr. *E. K. Burstal*, M.Inst.C.E., stated that, at the request of the petitioners, he had visited the district of St. Neots. Five years was taken for the construction of the proposed works; so that if the Bill passed, the hands of the Council would be tied for this period, whether any works were constructed or not. If the works were to be paid for in sovereigns, he could see no reason for taking capital powers to the extent of £15,000. The amount asked for was excessive in his judgment. He objected to the proposed sites of the wells, because the land was liable to be flooded. The adjoining land was used for market garden purposes, and was heavily manured. Water taken from such a place ought to be filtered. Between 1891 and 1896, there had been 56 Acts of Parliament relating to water undertakings in which scales of charges had been included; and he did not find in these Acts a single instance in which the rates were as high as those proposed in the Bill, unless they took the case of Sheffield, which was peculiar. Water drawn from the greensand was good when the iron was taken out—if it happened to contain iron.

In cross-examination, witness said he did not think it would be of great disadvantage to have to carry the water seven or eight miles.

Mr. FITZGERALD then addressed the Committee for the petitioners. He laid stress on the fact that the Bill did not emanate from St. Neots, and that since 1875 Parliament had devolved the charge of the water supply on the Local Authority. He also dwelt upon the serious burden which would be put upon that Authority when, in the future, they came to purchase the undertaking on arbitration terms from the Company. He pointed out that, if the Local Authority were allowed to manage the water supply, they will be able to raise the necessary £7000 on the credit of the rates at about 3 per cent. The town would be the owners of the water supply; and as soon as they had paid the interest on the money at 3 per cent. and the sinking fund and the costs of the working, any extra revenue which they derived would go in diminution of the water-rates. The circumstances would be very different with a Company, who would probably have to give a large share of their capital to the contractor in part payment. He asked the Committee to have regard to the wishes of the town, and not hand them over to a number of outside speculators, who were ashamed to put into the witness-box the gentlemen who had got up the Company.

Mr. WEDDERBURN having replied,

The Committee considered their decision in private. Upon the re-admission of the public,

The CHAIRMAN said that, under certain conditions, the Committee considered the preamble proved. They thought there should be some arrangement that if the water was not good and wholesome, provision should be made for filtration; and also that the supply should be constant. Flood-water should be kept out from the land to be taken by some embankment, if necessary; and the price should be modified from the figures stated in the Bill. Clauses should be inserted to enable the Local Authority to buy on fair terms; and the works should be begun within a year, and finished in three. These were only hints.

Monday, May 17.

To-day, the promoters brought up new clauses to carry out the decision of the Committee; and these were agreed to, with some amendment. The rates clause declared that when the rateable value exceeded £10, but did not exceed £20, the rate should be 9 per cent. per annum; £20, and not exceeding £40, 8 per cent.; and £40, 7 per cent. It was agreed that the Company should not be compellable to furnish a supply for any less sum than 8s. 8d. in any one year. The Committee decided that the petitioners should have the power of purchasing the works in two years, for such price as should be agreed upon by arbitration, but at not less than the actual sum reasonably expended by the Company. The Committee allowed the clause declaring that the Company should have power to pay 10 per cent. dividend on the capital.

The Bill was then directed to be reported, as amended, to the House.

Swansea Water Supply.—The Local Government Board have signified their consent to the borrowing by the Swansea County Council of £11,576 for the purposes of their water undertaking. The sum includes the cost of a service reservoir for St. Thomas.

LEGAL INTELLIGENCE.

Conviction for Stealing Gas.

At the North London Police Court last Saturday, Edwin Bodger, 38, of Mayfield Road, Dalston, was charged with stealing gas, the property of The Gaslight and Coke Company, on the 17th inst. and other dates. Mr. Humphreys, who prosecuted, said the accused had been in the employ of the Company as a service layer for about twelve years, and was always looked upon as a steady and honest man. On the 17th inst., Sidney Ball, a gas inspector, called at the prisoner's residence to take the register of the meter, when he found that a piece of lead piping had been soldered on to the service-pipe, passed round the meter, and soldered to the pipe supplying the house. By this means the gas consumed did not pass through the meter, and thereby the Company were defrauded. Mr. T. W. Colwell, an assistant-inspector, bore out this statement; adding that, when the prisoner was taxed with the offence, he cried and said, "What a fool I have been; I only fixed it on Sunday." He pleaded with Mr. Burgess, the Chief Inspector, for leniency because of his wife and seven children; but the matter was looked upon as too serious to be passed over. Mr. Burgess now said he had known the prisoner all the time he had been in the service of the Company, and considered him a most steady, honest, and reliable man; and he generally put him on any special work that was on hand. In reply to the Magistrate (Mr. D'Eyncourt), the witnesses said that, so far as comparisons with previous consumptions of gas at the house went, there was nothing to indicate that the connection had been in existence for more than a week, as stated by the prisoner. The Magistrate asked the prisoner if he would be dealt with at that Court or go for trial. The prisoner answered that he would prefer to have the matter settled at once. Detective-sergeant Parsons, who arrested the prisoner, said the latter admitted the offence alleged, and added that he had destroyed the connecting-pipe mentioned. The officer added that he had made inquiries, and found that the prisoner bore an excellent character, and, further, that he had had a good deal of domestic trouble owing to the illness of his wife and daughter. Mr. D'Eyncourt, in passing sentence, said it was both a sad and a serious case. The prisoner had most deliberately stolen the gas by putting on the connecting-pipe. This must have taken some time to accomplish, and therefore could not be pleaded as a matter of sudden impulse. He could not pass a lighter sentence than three weeks' imprisonment with hard labour.

MISCELLANEOUS NEWS.

GAS AT THE JUBILEE ILLUMINATIONS.

In the illumination of London last week in connection with the celebration of Her Majesty's Diamond Jubilee, gas, as on many previous occasions of public rejoicing, took a by no means unimportant part. The facility with which the architectural features of a building can be brought out by lines of gas-jets, and the appropriate devices which are available for illumination purposes, cause gas to be largely resorted to as the agent for brightening up the fronts of our dwellings or business premises at times such as the present. It must be acknowledged that public taste is limited mainly to the star, the crown, the letters "V.R.," and the scroll; but this is the fault of the selecter rather than that of the provider. Anyone connected with the gas industry who traversed after nightfall last week the portion of the route of the Royal procession lying north of the Thames would have had no cause to be ashamed of the display made by his illuminant.

Beginning at the westernmost point—the end of Piccadilly—Apsley House, at the corner of Hyde Park, and the adjoining houses had effective gas devices consisting of crowns, the dates 1837-1897, and appropriate mottoes and legends. At Lord Glenesk's house a plaster bust of the Queen was encircled by a wreath of laurel leaves, with "God Save the Queen" beneath. A striking illumination was to be seen at the Junior Constitutional Club, where a large number of red, white, and blue lamps were arranged round the windows and along the balconies in the form of a large Union Jack. A gas device forming the monogram "J. C. C.," was placed at the centre window over the first balcony, and others at the windows on either side forming the letters "V.R." Over the third balcony was the word "Victoria," flanked with the dates 1837-1897. The Bachelors' Club displayed a cut crystal medallion with a crown, bearing the motto "God Save the Queen" round the border, and the monogram "V.R.I." in the centre. At Devonshire House, opposite the east end of the Green Park, various gas devices, including the Imperial crown and the letters "V.R.," were to be seen. Turning down St. James's Street, where electricity had been largely depended upon for the illumination of the thoroughfare, Brooks's Club displayed a gas device with the initials "V.R." in illumination lamps, surmounted by a crown; at the Thatched House Club there was a large crystal medallion, with a crown above, and having a motto round the border; and at Boodle's, crystal gas-jet illuminations on a large scale were used. Passing into Pall Mall, at Marlborough House a branch of laurel of various natural tints, interspersed with red berries, was trained across the doorways and gateway, forming one main arch over the gateway and two subsidiary arches over the doors. The main laurel arch supported an oval medallion, surmounted by a Royal crown, and bearing the monogram "V.R.I.," surrounded by a Garter with the motto of the Order. At York House, close by, the illumination consisted of a wreath of white rose and pink May, with the monogram "V.R.I." in the centre in star-shaped gas-jets. The wreath was fixed in the Ambassadors' Court; and in Cleveland Row there was a similar device, flanked on either side by two heart-shaped arborescent devices bearing the dates 1837 and 1897. In Pall Mall, the Cavalry Club was illuminated by coloured gas-globes following the outline of the building. At the Athenæum Club, the gas illumination device included "Victoria Regina" in large letters over the porch, with six lighted braziers at the corners, and a line of gas-jets on

the three sides of the house. At the Oxford and Cambridge Universities Club, there were eight gas flambeaux and an Imperial crown; the whole of the upper part of the house being outlined with gas-jets. At the top of the Carlton Club was a large device lighted by gas; but the front of the house was illuminated by electricity. The Army and Navy Club was lighted up by lines of gas-jets round the top cornice and the centre of the building, with straight lines up each angle.

Before leaving the West-end, the illuminations at the residences of some of the Ambassadors may be briefly noticed. At the Belgian Legation, the illuminations consisted of a crystal medallion. At the German Embassy, they were in open gas-work. The monogram "V.R.," surmounted by a crown, appeared in the centre, flanked by the dates 1837-1897; and at either end of the building was a large star. At the Japanese Legation, the centre of the building was illuminated by a gas device, consisting of the Japanese flag and the Union Jack, with a chrysanthemum (the Imperial Japanese badge), beneath which was a ribbon bearing the above-named dates. The front of the Persian Legation was illuminated by gas; the device consisting of the English crown and the letters "V.R.I."

Coming into the Strand, the Golden Cross Hotel was brilliantly lighted up with coloured gas-lamps. At Coutts's bank, the same illuminant was employed. The "British Medical Journal," at the corner of Agar Street, had a large cut-crystal medallion; while the balcony at the "Globe" Office was outlined in gas, with the letters "V.R." and the usual dates. At the Lyceum Theatre, in addition to the flambeaux ordinarily used, the whole of the portico was outlined in gas; the columns being marked out with double lines, and having festoons of burners at the upper part of them. In arches formed between the three central columns were a star and the letters "V" and "R," the latter placed on either side. Gas was freely used in the illumination of this section of the route.

Entering the City at the Griffin, a very effective gas display was made at Child's Bank, on the south side of Fleet Street, by means of opal, amber, and pale blue lamps. The columns were lined with gas-jets, and the letters "V.R." formed the centre-piece; the balconies on either side bearing the dates 1837 and 1897. At the Law Courts branch of the Bank of England, on the other side of the thoroughfare, the illuminations also consisted of the letters "V. R." in amber cut crystal, and of two large shields in the same material with cut crystal centres, bearing the monogram "V.R.I." Each of the devices was surrounded by gold and green palm branches. At the corner of Chancery Lane, Messrs. Partridge and Cooper had a fine display; their principal windows being framed with gas-lamps of many colours. A little farther on, at the Law Life Assurance Society's offices, gas-jets outlined the whole of the building and the windows; the other illuminations comprising a large star, and the motto "God Save the Queen" in gas-jets. Almost opposite, at Hoare's bank, there was a large gas-lighted device in the form of an arc rayed like a rising sun, and enclosing a star and the letters "V.R." Two other stars completed the device. The newspaper offices in Fleet Street came out well; the "Daily Chronicle" making a brilliant display of coloured lights and a large crystal device.

Passing up Ludgate Hill, round St. Paul's Churchyard, and along Cheapside to the Bank, some very effective illumination devices were to be seen. But the Mansion House was, of course, the centre of attraction in the City. The whole front had upon it something like 5000 lamps of various colours. Some of these were used to "frame" the windows; and the effect was extremely beautiful. The gable, in the centre of which was a crystal device bearing the City arms, was outlined in lamps; and the six massive columns were traced with spiral lines of lamps, below which real evergreens were entwined. Between the two central columns was a crystal Imperial crown, supported by laurel wreaths of incandescent gas-lights, with the letters "V.R." on either side. Twelve Roman flambeaux at the top of the building completed the display, in which about 35,000 gas-jets were used. The illuminations at the Bank of England, with the exception of a few special novelties, were very similar to those adopted at the Jubilee of 1887, and at the wedding of the Duke and Duchess of York. They formed altogether a gorgeous display. Across the entire building, from Prince's Street to Bartholomew Lane, lines of crystal and amber illumination lamps were traced; falling along the lowest row into festoons looped up with bows. Over the entrance opposite the Royal Exchange was a crystal medallion with monogram "V.R.I.," two small medallions, bearing the dates 1837 and 1897, being on either side. Two cut crystal stars were also to the right and left. On the facia over the centre portico was the appropriate line, selected by the Governor of the Bank from Tennyson's "Ode to the Queen," "She Wrought her People Lasting Good;" the letters being formed in amber cut crystal on a groundwork of iridescent green embellished with gold. Surmounting the legend, which was a very prominent feature in the display, was a cut-crystal crown. Above this the blank window panels were outlined in crystal lamps, festoons of which, looped up with ruby bows, were drawn above them. The illuminations in the central part of the building were surmounted by a painting by Professor Legros, as mentioned in the "Journal" last week. This represented an "allegorical figure of Britannia in a chariot drawn by two horses, flanked on either side by children" holding shields bearing the dates 1837 and 1897. Along the parapet were four "glory stars," with crystal and amber points; and at each corner was a large cut-crystal ornament in the form known as "the Grecian honeysuckle;" the lines being marked out in deep ruby, and the scrolls finished with amber. The illumination on the front of the Royal Exchange was extremely simple; the object being to obtain the necessary effect as far as possible from the lines of the building. The pediment and frieze were outlined in small star-shaped gas-flames. Round the columns themselves were traced continuous spiral lines of amber illumination lamps. Cut-crystal letters, "V.R." and arborescent dates appeared between the columns. The illumination on the sides consisted of a cut-crystal medallion surmounted by a crown in the same material and surrounded by wreaths of green illumination lamps. On either side were displayed arborescent dates. The back bore a large crystal shell-piece over the entrance, flanked by crystal laurels.

The Bank of Australasia, in Threadneedle Street, was illuminated by a cut-crystal medallion, surrounded by laurels, and bearing the arms of the institution in the centre, surmounted by a crown. The letters "V.R.," in cut crystal, appeared beneath this device on the right and left; and at either end of the facia were shields, in decorated arborescent glass, bearing the dates. The Capital and Counties Bank was picked out with prismatic gas-lamps of colours harmonizing with the building, and there was a large crystal device, representing a medallion surrounded by a wreath of laurels. This bore in the centre the monogram "V.R." On the first floor was placed a "V.R." in gas-lamps. The illuminations of the Union Bank of Australia, Cornhill, consisted of a large cut-crystal oval medallion, with the arms of the bank in the centre, and surmounted by a crown, below which appeared the letters "V.R." on either side. Immediately above the ground-floor windows were heart-shaped shields of decorated arborescent glass, with the dates 1837-1897 in the centre. A festoon of amber illumination lamps appeared over the entrance; festoons of green being placed on either side. Alexander's Bank had an oval medallion, surmounted by a crystal crown of amber, ruby, and green, and with a heavy cut-crystal ornament at the foot. This device bore the motto "God Bless the Queen;" the letters "V.R." occupying the centre. The immediately adjacent angles on either side had in large cut letters "V.R." At the extremes of this building were scroll-shaped shields, bearing the usual dates. At the London and Westminster Bank, Lothbury, the illumination was composed of cut-crystal lamps. A line of illumination lamps ran along the cornice, and above it in amber illumination lamps were formed the dates 1837 and 1897 at either end of the building. The letters "V.R." in gas on either side were made in cut crystal; and the centre consisted of an oval medallion surmounted by a crown in the same material, and by laurel branches made in illumination lamps. As noteworthy examples of effective illumination in this part of the City, we may mention the Gresham Life Office and the adjoining Union Bank of London; the premises of the Liverpool, London, and Globe Insurance Company; the offices of the Commercial Union Assurance Company; and those of the North British and Mercantile Insurance Company.

The halls of the various City Companies were well illuminated. The main features of the Greek architecture of the Fishmongers' Hall, on the north side of London Bridge, were outlined with gas jets; Greek vases of gas being used at the corners of the building, and a large crown surmounting the centre of the east front. Over the centre gateway of the Vintners' Hall in Upper Thames Street, appeared, on a gas-illuminated scroll 14 feet in length, the motto "God Save the Queen;" and over each side gate was a star with the dates 1837 and 1897 in the centres. The illuminations of the hall of the Cordwainers' Company in Cannon Street consisted of the letters "V.R. 1837-1897" with the rose, thistle, and shamrock on either side, surmounted by the Imperial crown with two stars at the base. The illumination of Carpenters' Hall, London Wall, consisted of a large star and a line of gas-lights running the whole length of the buildings.

It need scarcely be pointed out that the foregoing notes refer mainly to the gas illumination devices used on one section of the route followed by the Royal procession. Exceedingly effective designs were, however, to be found on other sections—in fact, the desire to illuminate was very general. With regard to the consumption of gas on the 22nd, we may quote the following paragraph from the "Daily Telegraph" last Saturday: "It might be supposed that the London Gas Companies benefited largely by the extra quantity of gas consumed for the illuminations on Jubilee Day. But it seems, from an interview that a correspondent has had with Mr. G. F. L. Foulger, the Chief Distributing Engineer of The Gaslight and Coke Company, at their offices in Goswell Road, that this is not the case. 'Our Company,' said Mr. Foulger, 'is perhaps the largest in London, and so far from having gained by the Jubilee, we, as a matter of fact, are losers; and for this reason: On Jubilee Day, all offices and shops were shut, and people were generally absent from their homes; consequently much less gas was consumed in the usual way. The unusual consumption for the illuminations did not make up for this loss; and, comparing the quantity of gas consumed on Jubilee Day with that consumed on the corresponding day of last year, we found it to be nearly 4 million cubic feet less. We did not have to employ so many men at the works, and, of course, did not consume more coal—indeed, as will be readily understood, much less. Since business has been resumed, the average daily consumption may have risen; but the Gas Companies are generally losers by great public illuminations.'"

Mention may be made in this place of an interesting feature of the illuminations at Kingston-upon-Thames. It was a device put up by Mr. H. F. Packham, the Manager of the Kingston Gas Company, at their offices. It consisted of festoons of rosette gas-jets, and was accompanied by a display (which it is intended to make permanent) of a street-lamp containing an old iron burner, of the year 1837, and by way of contrast, a new lantern containing an incandescent burner of 1897, consuming the same quantity of gas as the other, but, of course, giving a very much greater amount of light. This striking demonstration of the advance in gas lighting between the two dates named attracted considerable attention.

The Price of Gas at Barry.—The Gas and Water Committee of the Barry District Council have agreed to recommend a reduction in the price of gas from 4s. 2d. to 3s. 9d. per 1000 cubic feet from the reading of the meter indices in the September quarter; an allowance of 10 per cent. for payment within fifteen days to be continued.

Proposed Transfer of the Kirkby Lonsdale Gas-Works to the District Council.—At the last meeting of the Kirkby Lonsdale District Council, it was reported that the shareholders of the Gas Company had authorized the Directors to enter into negotiations for the sale of the works to the Council. The resolution, it appears, was arrived at as the result of a conference between the Council and the Directors of the Company. It has been practically agreed that the price shall be fixed by two valuers, who, in capitalizing the profits, are to exclude the portion which arises in respect to the supply of gas to Casterton. Also when dealing with the portion of the works which is upon land belonging to the Council the valuers are, while reasonably appreciating the rights of the Council, not to unduly depreciate the claims of the Gas Company; due regard being given to the objects for which the gas-works were established, and to the fact that, to avoid putting the Council to the expense of an Act of Parliament, the Gas Company are prepared to leave out of calculation the profits from Casterton. A small Committee has been appointed by the Council to further the arrangements for the proposed transfer.

VISIT OF MUNICIPAL ENGINEERS TO THE STAFFORD GAS-WORKS.

A Midland District Meeting of the Association of Municipal and County Engineers was held at Stafford last Saturday; and in the afternoon a party of about sixty members visited the Stafford Gas-Works. Mr. J. Ferguson Bell, Assoc.M.Inst.C.E., the Engineer, conducted the party, and gave a short description of both the gas and electricity works. He said the works were purchased by the Corporation in 1878 for the sum of £77,022; being an average of £262 per £100 of share capital. Since they had been transferred to the Corporation, they had been almost entirely rebuilt; and when the extensions and alterations now in progress were completed, they would have a productive capacity of 1½ million cubic feet of gas per day. The retort-house was 65 feet wide inside and 156 feet long; and there were three benches of retorts. The two new ones consisted of four arches, in each of which there were nine through retorts, 16 in. by 22 in., and 20 feet long. The retorts were heated by Bell's regenerator gas-furnaces; there being one producer to each arch of nine retorts. At the time the works were purchased by the Corporation, the price charged for gas was 4s. per 1000 cubic feet. It now varied from 2s. 3d. to 2s. 9d. net—the average being about 2s. 6d.; and no meter-rents were charged. It was interesting to note that considerably over one-third the quantity of gas sold was now used for cooking, heating, and motive power; and notwithstanding the introduction of the electric light, the consumption kept regularly increasing. The capital invested in the gas undertaking was £103,884, from which £28,365 had been repaid in reduction of capital account; leaving £75,519 now owing. In addition, £29,100 had been handed over in reduction of rates. In answer to questions put by members, Mr. Bell referred with satisfaction to the very large consumption of gas in Stafford for cooking and manufacturing purposes. He said they were at present supplying more gas between the hours of 6 a.m. and 6 p.m. than they were between 6 o'clock at night and 6 in the morning. Another system which had been introduced with very great success was the prepayment, or "penny-in-the-slot," meter. They had now about 900 consumers of this class; and they believed that eventually there would be 1600, and that practically all the people of Stafford would become gas consumers. The Corporation put the whole of the fittings into the houses free of cost to the consumers, and charged on a slightly higher scale for the gas to cover this expenditure.

Votes of thanks to Alderman Peach, the Chairman of the Electricity Committee, and Mr. Bell were proposed by Mr. Lobley, of Hanley. He said this was the first occasion on which he had seen in England the gas and electricity works under one roof and one management; and it was very satisfactory to notice that there was no rivalry but that of emulation between them. It was a mistaken idea to suppose that electricity was going to do harm to gas; indeed, they had proved the contrary in Stafford. Alderman Peach, in responding, said the Corporation were determined to maintain the monopoly of public lighting in Stafford. They obtained their Provisional Order for electric lighting when they were threatened by an outside Company, as the Corporation felt it would have been a suicidal policy to allow another party to come in and supply the electric light.

EDINBURGH AND LEITH GAS COMMISSIONERS.

The Annual Accounts.

The accounts of the Edinburgh and Leith Gas Commissioners for the year ending the 15th of May have been issued, subject to audit, and along with them a short summary is given by Mr. John S. Gibb, the Treasurer This document shows as follows: The surplus on the year's working is £40,571. In relation to this surplus, there has been paid: For annuities, £33,746; Edinburgh-Portobello gas annuities, £600; amount transferred to sinking fund in respect of annuities redeemed, £254; ditto in respect of mortgages redeemed, £139; interest on mortgages, &c., £5532; expenses of mortgages, £343; expenses of transfer of Portobello gas undertaking, paid May 15, 1897, £196. The sums amount together to £40,810. After meeting these charges, there is a deficit of £239, which, being deducted from the amount brought forward from the year 1895-6, after taking away contributions to sinking funds, &c.—£33,732—makes the total sum at the credit of profit and loss account £33,493. This is subject to the statutory minimum charges for the sinking fund, as follows: (1) For repayment of money borrowed, £1804; (2) for redemption of annuities, £7209—together, £9013, which being deducted from the above sum leaves a balance of £24,480, which may be dealt with by the Commissioners, in terms of their Act. As to the deficit of £239 on the year's working, Mr. Gibb points out that the price per 1000 cubic feet of gas was fixed on the 1st of October last at 3s.; being 0·35d. lower than the net cost was estimated as likely to be. This, for the period to which it applied, represents some £1500. The amount expended on the new chimney at New Street during the year added a further sum of £5300. Taking only this latter sum into account, the present year's deficit would, he says, have been a surplus of about £5000 had the chimney not been required.

The accounts show the stock capital, consisting of shares in the Edinburgh and the Edinburgh and Leith Gas Companies, to the amount of £350,000, to be now £347,179. The reduction has been effected by the redemption of annuities, which were originally £34,000, but are now £33,726; the sum of £274, representing stock of the value of £2820, having been redeemed. Of a total authorized loan capital of £400,000, there has been borrowed £180,398, at rates of from 2½ to 3½ per cent. interest, to which, in terms of the Commissioners' Act, there falls to be added £4300 of mortgages redeemed, which leaves the borrowing powers remaining at £215,302. The capital account amounts to £549,532, of which £17,786 was added during the year. Of the additions, £13,617 was expended upon main and service pipes and cost of laying, £3497 upon gas-meters, and £648 upon gas cooking and heating stoves. There is a debit balance of £14,834 on the capital account. The revenue amounted to £243,330, of which there was derived from the sale of gas (1,516,939,100 cubic feet), less credits, £222,072; from coke, £6206; from tar and ammoniacal liquor, £14,576; from waste lime, £72; from rents £388; and from transfer fees, £15. The expenditure amounted to £202,759. Of this sum, the manufacture of gas cost £156,079—coal (162,816 tons) costing £91,272; purifying materials, oil, water, &c., used in works, £8390; salaries and wages, &c., £39,896; and repairs and maintenance of works and plant, including a portion of the outlay on the new chimney at the Edinburgh works, £16,520. The distribution of gas cost £27,103, of which £9419 was for salaries and wages, £11,996 for repairs and maintenance of pipes and attendance at gas-holders, and £5688 for repairs and maintenance of meters. The cost of management amounted to £7241; feu duties, to £267; rates and taxes, to £6360; pensions and allowances, to £727; accidental damages, to £90; and discounts, abatements, and bad debts, to £4889. The sinking fund for repayment of money borrowed amounts to £8121; the sinking fund for redemption of annuities, to £74,393; and the reserve fund, to £3090. During the year there was expended upon the erection of carburetted water-gas plant in the Edinburgh works, £21,723; upon a new retort-bench in the Leith works, £506; and placed to the account for the acquisition of the Portobello gas undertaking, in terms of the agreement made with the city of Edinburgh, £2554. There was received for the hire of gas-stoves £765; for stoves sold, £419; and for fitting up stoves, £193. The value of the gas-stoves on hand or lent on hire on the 15th of May last was £4028. The cost of stoves purchased during the year amounted to £1553.

THE FATAL GAS EXPLOSION IN BOSTON (U.S.A.).

The Reports of the Massachusetts Gas and Electric Light Commissionerr.

In the "JOURNAL" for the 25th of May, we gave a full summary of the report of Judge Ely, of the Boston Municipal Court, on the fatal gas explosion which occurred in that city on the 4th of March; and last week we noticed in our editorial columns the report of the Massachusetts Board of Gas and Electric Light Commissioners on the matter. The point of the explosion, it may be remembered, was at the junction of Boylston and Tremont Streets. It was caused by the accumulation of gas under a temporary bridge maintained flush with the surface of the street; the bridge being one of the necessary structures in making a subway, at the time very nearly completed at that spot. The Board held their inquiry under an order received from the Senate and House of Representatives; and it extended over 38 days. The City of Boston, the Boston Transit Commission, the Metropolitan Construction Company, and the Boston Gaslight Company were represented by Counsel during the entire hearing; and, in the latter portion, the Edison Electric Illuminating Company of Boston also. There were 83 witnesses called by the Board and examined under oath, including many officers and employees of the Companies named. All these officers and servants attended at the request of the Board without formal summons; and they seemed ready and willing to render whatever assistance was required. The evidence occupied 4495 type-written pages. In their report, the Board set forth at some length the material and important facts brought before them, and come to the following conclusions:—

That the explosion was due to the ignition of a mixture of illuminating gas and air confined in the space between the subway and the bridge by a spark from the electric current of the West End Street Railway Company; and that the gas came from one or more breaks of the pipes of the Boston Gaslight Company within the excavation. That the first of the breaks occurred at or shortly before nine o'clock in the forenoon of the 4th of March. That the first break in the pipes may have been the most westerly one in the 6-inch, or that in the 8-inch; but that, in view of the fact that the 6-inch at that point was unusually thin, and had a serious defect, the 6-inch was probably first broken. That such fracture was probably the result of a constant jar or succession of slight blows, continued for several months, caused by the passage of the electric cars over the bridge, and transmitted through certain bridge timbers to a point above, or nearly above, this pipe, outside the excavation, and thence from the earth to the pipe.

That, except as to the defects noted, the pipes were of the kind and quality usually employed by gas companies, and that neither the Gas Company, the Contractor, nor the Transit Commission knew, or had reason to know, of the existence of any defects; and that there was nothing in the appearance or the mere age of the pipes which demanded of them any greater care than is usually required for pipes exposed when excavations are in progress.

That the bridge was properly constructed, and that no part of it rested upon, or interfered with, the proper support of the pipes; and that the gas-pipes were properly supported at all times after the earth was removed from around them.

That the Engineers of the Gas Company and the Commission, as well as the principal employees of the Construction Company, were well aware of the great fragility of cast-iron pipes, and of the liability of gas and air to ignite and explode when confined in a closed pocket. That no provision was made, by the terms of the contract, by any instruction from the Engineers of the Commission, or by any act of the Contractor, for a reasonable ventilation of this enclosed space when work was not going on. That the provisions of the contract, which required all of Boylston Street to be kept open for traffic during the day, made it difficult, if not absolutely impracticable, to secure such ventilation; and that this provision was not required by the statute, but was inserted by the Commission, in the exercise of its lawful discretion.

That the police officer at this crossing neglected for more than an hour and a half after he began to notice the escape of gas to notify the Company of the leak, although he was at that intersection almost continually, and was almost continuously annoyed by the odour of gas.

That the Construction Company did not carry out a system of regular inspection of the structures when work was not going on; and that the supports of the bridge were not visited or inspected by any of the principal foremen of the Construction Company during the four days previous to the explosion, although, by the terms of the contract, watchmen, red lights, &c., were required for the protection of life and property.

That the Gas Company had a sufficient force of experienced and skilful jobbers to care for all leaks that could reasonably be expected to occur, and that it had a sufficient number of such employees on the day of the explosion to care for this leak and others; but that it failed to do so

because of an inexcusable lack of discipline and lack of reasonable skill and attention to the management of the jobbing department and the employees who composed it.

That, from the inception of this great undertaking, the responsible management of the Boston Gaslight Company failed to render to the conduct of the work that degree of cordial co-operation and assistance which its gratuitous privileges in the streets and its peculiar knowledge of the dangers to be encountered reasonably demanded that it should render; and, as a distinct part of this attitude, wholly failed to impress upon the Company's subordinates the peril to life and property which might result from any lack of the most assiduous attention.

That, if more emphatic instructions respecting attention to complaints of leaks which were to be expected along the line of the subway had been given, the two complaints received from the corner of Boylston and Tremont Streets would have been more promptly attended to; and it is reasonable to believe that the foreman of the main department would have given to the escape of gas which he noticed when passing the bridge his immediate and personal attention.

That, in the light of the event itself, this explosion might have been averted if any one of the following things had been done:—

1.—If reasonable provision for ventilating such spaces had been required by the contract or by the instructions of the Engineers of the Commission or by the act of the Contractor.

2.—If the Contractor had employed a capable and reliable watchman, when work was not going on, who would probably have passed over this bridge at some time during the two hours which elapsed after the gas was first noticed, and would have notified the Gas Company.

3.—If the police officer had exercised reasonable diligence in notifying the Gas Company after he had knowledge of the leak.

4.—If reasonable skill and activity had been applied in the management of the jobbing department of the Gas Company, so that one of its jobbers had been sent with reasonable promptness on the complaint from the Masonic Temple, or upon the later complaint received from the police officer.

The work of the subway throughout its length was one of unusual hazard and extraordinary difficulties. Life and property were both imperilled; and the danger to the latter was perhaps the more obvious. It is doubtful if the difficulties encountered at the intersection of these streets, in the number and character of the underground structures met, in the enormous amount of street car and other traffic to be maintained without interruption, and in the nearness of the new structure to the surface of the street, were ever paralleled in any public work.

The order does not require, and the Board has not undertaken, a determination of the legal liability of any of the parties interested, but rather, after such study of the testimony as was possible in the time available, to deduce therefrom such facts and conclusions as, in the light of the event itself, seem most important for future consideration.

The report of which the foregoing is the concluding portion is signed by Forrest E. Barker and Morris Schaff. As already mentioned, a dissenting report was presented by Mr. C. H. Gifford. It is as follows:—

I regret that I am compelled to differ from my colleagues as to their findings wherein the weight of the same tends to implicate the Construction Company beyond what I feel is justice to them.

As I look at it, there can be no division of interests and responsibility as between that Company and the Transit Commission. The contract made by the Transit Commission with the Construction Company required certain safeguards to be thrown about this work for additional protection to life and property. If the Construction Company failed to comply with that contract in any respect, it was the duty of the Transit Commission to see that it was fully carried out. I am of the opinion that the Transit Commission did not look after the Construction Company as to a regular inspection of the bridge structure and the pipe supports when the work was not going on, and see that the terms of the contract as to watchmen, red lights, &c., required for the protection of life and property, were fully complied with.

The testimony of the members of the Construction Company and the West End Railway roadmasters as to the bridge construction was much at variance. An employee of the Transit Commission, after having taken some measurements as to the depth of rails, &c., succeeded in demonstrating a bridge of such a character as would avoid the 6-inch gas-pipe; and there is no desire to doubt his accuracy. It appears to have been an irregular structure, not only as to the top timbers, but also in portions of its lower construction, all rendered necessary to avoid the numerous pipes in that location. It depended on its own weight, and such assistance as the rails of the West End Road could give, to keep it in proper position. The supports for this bridge and the pipes were subject to great and almost continuous changes, rendered necessary by the character of the work. There can be no doubt, taking into account the whole situation, and the relation of the timbers that formed that bridge to the pipes, that a portion of the bridge was dangerously near the offset of that 6-inch gas-pipe. That this bridge could have withstood the strain and jar of the enormous traffic and thousands of electric cars that crossed it daily, together with other natural causes, and not come in contact with that pipe, is truly astonishing. The most remarkable part of the testimony is that the close relation of that bridge to the pipe was not the subject of such special inspection at any and all times as it seemed to require. A very slight settling of the bridge, which, as I have before intimated, it would be reasonable to expect from change in supports, coupled with climatic changes as to the earth supports at the surface, together with a very slight deflection (and at that point it would probably escape notice), would have brought the bridge and 6-inch pipe in contact. The character of the middle break in that pipe suggests such an analysis of the situation. If this should be the solution of the problem, the Transit Commission should also be held coequal for such lack of care as it was their duty to have given this structure.

It is a grave question if the extension of time beyond the terms of the contract to complete this section is not quite a prominent factor as to the cause for this explosion; but the reasons given appear to have been satisfactory to the Transit Commission, and all large enterprises are liable to more or less delay. If the Construction Company are in any way liable on that account, the Transit Commission also enter into it for acquiescing in, and not making a suitable protest against, the same.

The attitude of the Gas Company should be more fully set forth. They not only refused to re-locate their pipes, as the Subway Act required, but practically abandoned the care of them to the Transit Commission and the Construction Company. The wisdom of such a policy is very doubtful. They knew the article they dealt in was not only dangerous to life and property, but a constant menace to the same during the whole period of this construction. The only assistance they would render was an arrangement to respond to calls in case of leaks, and furnish a man to look after the gates, to see that they were clear of any obstruction if it should be necessary at any time to shut off the gas.

They apparently desired to relieve themselves from any responsibility in case of accident. Relief under such conditions, as a rule, is dearly bought. It was a duty they owed not only to the public but to themselves to render all assistance possible as to the care of their pipes. A competent man employed to have a constant care and oversight of them would have materially aided the Construction Company, and would have shown that they fully considered the public safety and welfare a part of their obligation for the privileges they now enjoy. Their jobbing department system shows that much thought and attention has been given to perfect it. It might appear to some to be overburdened with detail; but the fact is, when the emergency arrived, it failed to act. I do not wish to criticize the system; but, with what was claimed for it, there was certainly a lack of executive ability somewhere in carrying it out.

The Edison Company was nearer a factor in this investigation than the report goes to show. Had it not been for the small length of pipe burned out and the direct testimony given as to the record shown by the sensitive automatic indicator at their office, this Company might have been in a very different position as to the findings in this report. That a gas of such quality and in such quantities can be generated by their underground construction as to produce this explosion, was clearly demonstrated. I only mention this to show that it is not always the Gas Company that is to be criticized for apparent leaks of gas.

I agree with my colleagues in the other parts of their report. It is not a strong document, in the light that more specific findings are not made, and that mostly theories have been adduced. From the testimony offered, it is absolutely impossible to state the direct cause for this explosion and loss of life; but the impression on my mind was that lack of constant care on the part of all parties in interest was possibly the cause. No one can realize, who did not listen to the whole testimony, the wonderful piece of engineering work that the Transit Commission and the Construction Company had to perform, and the great care they gave to their work But, if the lack of extra care required was the cause of this explosion, let each of the three parties in interest share such portion of it as their interests and attitude towards the same would seem to require.

ELECTRIC LIGHTING NOTES.

The Northampton Town Council have appointed a Committee for the purpose of considering the propriety of taking steps to purchase the plant of the local Electric Light Company.

Some weeks ago, we referred to the electric lighting at the Central Meat Market, Smithfield, and the competition of gas therewith. We now learn that on Midsummer Day nearly a hundred of the salesmen discontinued the electric light in favour of gas on the regenerative system. Electricity has been found too dear.

There seems to be a little vacillation among the members of the Maidstone Town Council on the question of electric lighting. Sitting in Committee, the Council recently determined, by (we are told) a large majority, to reject the offers which have been made for their Electric Lighting Order, and to retain it in their own hands. When, however, this decision was brought before the Council at an ordinary meeting, only eight members supported it, against eight who were in favour of an amendment that the Order should be disposed of to a proposed Company. The Mayor (Alderman Dr. Oliver) thought it was his duty not to give a casting vote either way at this juncture; and therefore both propositions fell to the ground. The members who favour the retention of the Order are convinced they will carry their proposal on the next occasion.

An extraordinary story comes from Torquay. When the Town Council of the borough decided to go in for the electric light, it succeeded in persuading itself that the only possible site for the generating station was the Beacon Quay cellars, immediately contiguous to the Bath Saloons. Fear was expressed at the time that the vibration of the machinery or the smoke from the boilers would prove a nuisance; and that in one way or another the proximity of the electric light works to the Saloons would be detrimental. Assurances were given that there was no cause for alarm; and the works have gone on. Now that the excavation is partly done, it turns out that the fears were not altogether groundless. According to one local paper, it is found that "not only some of the boilers but all the stoking would be directly under the Saloons, which is the only large concert and assembly room in the town," and that there is danger not only of annoyance, but risk of injury to the asphalte floors of the Saloons. Another paper placed the matter in a less serious light, though it too indicates that the people of Torquay are running a foolish and unnecessary risk of injuring in one way or another the buildings which are the scene of most of the local popular social gatherings. This second statement of the position is that the site selected for the boilers is dangerously near the foundations of the outer wall of the larger saloon. However, the work has been temporarily stopped, another cellar has been added to those selected for the electricity works, and the plant will be differently distributed. Torquay is invited by its local papers to congratulate itself that things had proceeded no further before the present unpleasant discovery was made. As it is, a little money has been thrown away in unnecessary excavations; and the extension of the site will involve a sacrifice of a rental of £20 a year, which it now yields as stores. But this is nothing to what it must have meant if the erection of the works had proceeded further.

Reductions in Price.—The price of gas at Southwick will be reduced from 3s. 8d. to 3s. 3d. per 1000 cubic feet from the 1st of July. The Directors of the Dudley Gas Company have reduced the charge for gas used by gas-engines to 2s. 6d. per 1000 cubic feet as from Midsummer. The Directors of the Leominster Gas Company will reduce the price of gas from 3s. 9d. to 3s. 4d. per 1000 cubic feet on the 1st prox.

BIRMINGHAM CORPORATION WATER SUPPLY.

Annual Report and Accounts—Important Results from a House-to-House Inspection.

The Birmingham City Council will to-day have submitted to them the report and accounts of the Water Committee for the year ending March 31. The water-rents show a total increase of 6·58 per cent. over the previous year. This result is partly due to the increased rental consequent on a portion of the benefit derived from house-to-house inspection having been taken into account during the year. Deducting this, the percentage of increase attributable to natural growth is found to be 4·85 per cent. The cost of pumping shows an increase of £1184. A considerable part of this is attributable to the fact that the total distribution of water during the year has increased from 5794 to 5971 million gallons. But, after making allowance for this, the cost of pumping proportionately to the water distributed has increased. This is principally due to the increase in consumption of water in the higher levels, for the distribution of which water has to be pumped two and three times over; so that, although the cost of pumping per 1000 gallons pumped shows a reduction, the cost per 1000 gallons distributed exhibits a slight increase. This is an element in the administration of the department which, in the nature of things, will tell with accumulating force so long as the supply is given as at present by a pumping system. But for the economies in coal consumption which have been effected at the larger pumping-stations, it would have had a more serious effect during the year. The receipts on revenue account total to £202,059, which is an increase of £12,189; while the total charges present a reduction of £467—giving an increase of £12,656 in the amount carried to profit and loss. The profit and loss account shows a balance of £25,812, against £17,718 in the previous year. The profit has been carried to the special water fund in accordance with the Act of 1892, making the total amount now standing to the credit of this fund £78,335. The house-to-house inspection, which was commenced in February, 1895, has now been practically completed. The total number of premises inspected has been 154,983; and as a result thereof, a large amount of valuable information has been obtained. The charges on all the accounts have been compared with the scales; and wherever a difference has been found, the necessary adjustment has been made, whether of reduction or increase—the net result being that about £6000 a year has been added to the rental. As an incidental result of the house-to-house inspection, a considerable number of open supplies for trade purposes have been converted into measured supplies; and the policy of steadily introducing meters in all cases of considerable trade supplies where circumstances appear to render this course advisable, is still being pursued. The greater part of the increase in the average daily distribution of water is in the measured supplies, and is attributable, therefore, to trade consumption. The consumption under the head of domestic, unmeasured trade, fire, and waste, shows a further reduction in the quantity supplied per head per day. The accumulated result of the saving effected during the last three years in this direction is equal to 2·16 gallons per head per day, which, on the present estimated population, gives a total of 1½ million gallons per day. The Committee attribute the saving to the more rigid system of inspection for waste which they are pursuing, combined with favourable weather during the past winter. In their report presented to the Council on May 21, 1895, the Committee referred to an action brought against the Corporation to recover damages for repairing service-pipes laid by the Corporation, which had been found to leak. The pipes had been laid in ashes; and the Judge of the County Court, before whom the case was heard, gave a decision against the Corporation, holding that there had been negligence in omitting to afford protection to the pipe. Upon this the Committee arranged with Professor Percy Frankland, of Mason College, to conduct a series of experiments with lead pipes, coated with several different materials, with a view to ascertaining their power of giving protection against corrosion. The Committee were advised that the simplest, as well as the most efficient, manner of giving the protection required would be to lay the pipes in a wooden trough filled with a preparation of bitumen. In considering the manner in which the use of the protective medium could be most conveniently introduced, the Committee came to the conclusion that it would be best to enforce the protection in the case of all new services; and at the same time to undertake the liability of maintaining services between the main and the consumer's premises—a responsibility which had hitherto been thrown on the consumer. The Committee therefore determined, in revising the scale of charges for service-laying, to make such an addition to the charge for each service as should cover the cost of the protection afforded. Small services heretofore charged at 30s. and upwards, have been raised by 8s.; and the larger services of 40s. and upwards, by 16s.

Regarding the Elan supply works, the Committee record that the amount expended on the works in the Elan Valley during the year ended March 31 was £118,103—giving a total to that date of £333,652. The total rainfall registered on the watershed in 1896 was 61·79 inches. A contract has been entered into with Mr. Abram Kellett, of Ealing, for the works at Frankley; the amount of the contract being £314,428, and the time allowed for completion four years.

CAPE TOWN WATER SUPPLY.

After taking some time to think about it, the Progressive members of the Corporation of Cape Town decided not to resign in consequence of the vote of the ratepayers against the proposed improvement schemes. Instead of doing so, they adopted a suggestion that further information respecting the proposals should be circulated, and a fresh appeal made to the burgesses for their sanction to the expenditure. In accordance with this decision, another public meeting was held on the 6th ult., at which the rejected portions of the improvement scheme were again submitted to the popular vote. Among them was a proposal to construct another reservoir on Table Mountain, with a capacity of 200 million gallons, the cost of which is estimated at £112,000. In support of this project, it was stated, on the basis of a report prepared by Mr. T. Stewart, the Water Engineer, that, notwithstanding the fact that a large reservoir on the mountain has just been completed, it is necessary to provide more storage if the Municipality are to keep pace with the growth of the town and port, and the consequent increasing demand for water. The consumption is now about a million gallons per day; and there is at presents storage capacity for 225 million gallons. As, however, the dry season extends over an average of 150 days, the actual margin is only about 75 million gallons, or really only 55 millions which can be guaranteed free from sediment. The demand is increasing at the rate of about 23 million gallons per annum; so that the margin is likely to vanish in the next three years—a period which will be occupied in the construction of the new reservoir. These arguments were apparently deemed conclusive by a majority of those who attended the meeting, for the scheme was approved by 174 votes to 52. A poll was, however, demanded. Under the law as it stands, it appears to be necessary to obtain the sanction on a poll of an absolute majority of the electors; and as on the previous occasion only a very small proportion of them took the trouble to vote, the Council seem to be still confronted by a very considerable difficulty. It is suggested, however, that application should be made to the Cape Legislature to amend the law so as to provide that a majority of two-thirds of those voting shall be sufficient to sanction municipal enterprises.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

In common with the residents in other parts of the British Empire, the people of Scotland have this week been holding festival in celebration of the Diamond Jubilee of Her Majesty the Queen. I am not aware of its having had any perceptible effect upon gas undertakings. There is so much daylight in Scotland at this season of the year, that illuminations would have little effect; and consequently there was almost no attempt to celebrate the occasion in this way. So far as I have seen, the only place where anything like a public illumination was undertaken was at Paisley, where the Corporation entrusted the work of illuminating the public buildings to Mr. G. R. Hislop, the Gas Engineer to the Corporation; and it is reported that he made a very effective display. The only other item of news I have observed—but the writings on the subject of the Jubilee have been so voluminous that it would be easy to overlook much—was that the Largs Gas Company gave 12 tons of coal to the local committee who prepared the bonfire of the district. By the way, the bonfires were a great feature of the celebrations. I myself counted 38; and had it not been for the mist which was hanging about some of the hill-tops, a good many more would have been visible.

The accounts of the Edinburgh and Leith Gas Commissioners for the year ending May 15 have been prepared by Mr. J. S. Gibb, the Treasurer, and will be presented to the Commissioners on Monday. They are still subject to audit, but may be taken as quite accurate. The year has been an eventful one with the Commissioners; and the undertaking has passed through a severe ordeal. When engaged in such important works as the erection of carburetted water-gas plant, and of a new chimney, and arranging for the taking down of the old chimney, they were called upon to perform an operation very much resembling, and quite as dangerous as, the proverbial "swopping of horses in mid-stream." Both the Engineers to the Commission were removed by death during the year; and the Commissioners have been able to consolidate their staff by having only one Engineer—a state of matters which they have been looking forward to since their creation in 1888. The time has been one of strain, but not of stress; for, despite the troubles of the undertaking, the business has continued to improve. A sign of the sound health of the Commission is to be found in the increased consumption of gas, which was 92,707,700 cubic feet more than in the year preceding. I find that in the twelve months before that, the increase was 49,000,000 cubic feet; and in the year before that, again, it was 103,000,000 cubic feet. Since the year 1889-90, which was the first complete year of the Commission, the annual consumption of gas has gone up 366,000,000 cubic feet, or not far short of 25 per cent. The revenue from the sale of gas amounted to £222,072, or £10,733 more than in the year preceding. All through the period dealt with in the accounts, the price of gas was 3s. per 1000 cubic feet; and thus the additional revenue is the natural result of increased business. Residuals realized £20,854, which is £222 less; and when the increased quantity of coal which was used is taken into account, it is apparent that the return from residuals must have been very poor. The amount of coal used was 162,816 tons—an increase of 11,699 tons. The gas sold is given as 1,516,932,100 cubic feet, which, I find, works out to 9316 cubic feet per ton of coal carbonized. In the previous year, the quantity was 9360 cubic feet; and in the year before that it was 9655 cubic feet. That is to say that two years ago 339 cubic feet more gas was being got out of a ton of coal. This is equal to nearly 50,000,000 cubic feet of gas which has not been realized; and it represents a loss of about £7500. Lord Provost M'Donald has, on more than one occasion, remarked that when the new Manager got a grip of the business, matters might be better. Probably this was one of the things he had in view. It was not a courteous remark, to those who had charge of the works. I am sure that Mr. Herring will not rest content until he either converts this loss into a gain, or can explain why it cannot be done. He cannot be held responsible for the period dealt with in the accounts, because he only had the works under his charge for six weeks of that time. On the expenditure side, coal cost £88,272, or £3228 more than in the previous year; purifying materials, oil, water, &c., cost £8390, or an increase of £454; salaries and wages amounted to £39,896, or an increase of £975; and repairs and maintenance of works and plant cost £16,520, or an increase of £6060. Of this latter sum, however, £5300 was spent upon the new chimney in the Edinburgh works. Distribution of gas entailed an expenditure of £27,103, or an increase of £2970; management cost £7241, or a decrease of £216; and rates and taxes amounted to £6360, as compared with £10,053, or a decrease of £3693. The great decrease in the last item is worthy of comment. It arises from the fact that last year the working of the undertaking resulted in a profit of £102, or, if sinking fund charges were taken into account, a deficit of £8419. The works and plant were assessed, in consequence of this result, at a much less sum than they were in the previous year, when a profit of £21,575 was made on the working, and a balance of £50,536 was carried forward. The Commissioners have found out that it is not advisable to make a large profit. They have succeeded this year. There is a balance

of profit, on the working, of £40,570; but the charges upon that, for the payment of annuities, interest, and the like, absorb the whole fund, and would require £239 more. This sum accordingly, together with the statutory sinking fund charges amounting to £9012, must be taken out of the £33,732 which was brought forward from last year—reducing it to £24,480. This latter sum the Commissioners may deal with in various ways. They will probably carry most of it forward. Their policy for the past year or two has been to do so, and to gradually reduce the amount of this account, so as to get into the position of making each year stand upon its own base. I see the Editor of the "Scotsman" takes the Commissioners to task for this policy, which he says can in no sense be said to be good finance; and he goes the length of suggesting that 1½d. or 2d. might be added to the price of gas, in order to make the undertaking sound from a business point of view. Well, in the abstract the Editor is right. But this is just one of those instances in which circumstances alter cases. The Commissioners earned too large a surplus two or three years ago; and they are now working it off in a most sensible way. Nobody who knows the circumstances, or who is desirous of seeing the undertaking flourish, would have suggested the raising of the price of gas at this time. When the chimney troubles are got over, there will be a saving of £5000 at once. I observe also that the Commissioners have, during the past year, been discharging mortgages at 3½ per cent., and issuing new ones at 2½ and 2¾ per cent., by which means a further saving will be effected. Then, if the price of residuals would rise, the Commissioners would at once be in a position to earn a profit on the present price of gas. At all events, it is not advisable just now to raise the price. On the other hand, it is not likely that there will be any reduction.

The Corporation of Dundee have this week resolved to curtail their Bill which is now in the House of Commons, by striking out the police and sanitary clauses, and retaining only those relating to the gas and electric light undertakings. At a meeting of the Town Council on Monday, the Clerk (Sir Thomas Thornton) reported that there were still three Bills before the Dundee Corporation Bill in the Parliamentary Sanitary Committee; and it was not expected the Committee would reach the Dundee Bill until about July 12. In these circumstances, he had asked the two members of Parliament for the city to attend before the Chairman of Ways and Means, in order to try and induce him to divide the Committee into two, with the view of the Dundee Corporation Bill and other Bills after it being immediately taken up by the second division of the Committee, and thus to ensure the Bill being disposed of this session. It appeared, however, that the Chairman had refused to do this, unless it was certified that the building and sanitary provisions of the Bill were absolutely indispensable for Dundee during the present year; and this, of course, could not be certified. The Chairman had offered to continue the Bill till next session, so that it might then proceed from the point which it had reached this session without further notices or expense of any kind. Seeing that Parliament would, it was expected, rise pretty early this session, two alternatives were open to the Council. They might proceed with the gas borrowing and electrical clauses alone. If this were done, the Bill would be discharged by the Sanitary Committee, and would come before the Unopposed Committee; and the Parliamentary Agents assured him it would then easily pass this session—provided, of course, the present petitions against the sanitary and police clauses were also withdrawn, which it was reasonable to suppose they would be if the clauses objected to were deleted. The alternative was to adopt the suggestion of the Chairman of Ways and Means, to carry over the whole Bill to next session from the point it had reached this session; and the Bill would then be taken up and disposed of at an early date next session. There was a good deal of discussion on the subject; and the proposal to drop the police and sanitary clauses, and to retain only the portion authorizing the Corporation to borrow money for the extension of the gas and electric light undertakings, was only carried by the casting vote of the Lord Provost.

The Broughty Ferry Police Commissioners, on Wednesday night, considered the report by Mr. J. Hepworth, of Edinburgh, on the condition of the Corporation gas-works. The first question was whether they should continue the use of the Peebles oil-gas process. They had before them a report as to the cost of making gas by the two systems. From this it appeared that, assuming there would be an increased consumption of gas to the extent of 500,000 cubic feet, coal and oil would cost £2414, less £1177 10s. for tar and coke—making the net cost £1236 10s., or equal to 8·05d. per 1000 cubic feet; and that the cost of coal alone would be £2476 13s., less £670 for tar and coke—making the net cost £1806 3s., or equal to 11·76d. per 1000 cubic feet. Thus the advantage of using the Peebles oil system was once more demonstrated. The figures settled the question; and it was resolved to continue the process. The Manager (Mr. A. Waddell) reported that the cost of the alterations upon the oil-gas plant recommended by Mr. Hepworth, would not exceed £30; and he was instructed to proceed at once with the work. Mr. Waddell was requested to prepare plans for the new gasholder, to be erected on the site of the existing middle holder.

The annual meeting of the Galston Gaslight Company was held last Tuesday, when a dividend of 7½ per cent. on the original capital was declared. The price of gas is 4s. 7d. per 1000 cubic feet. The Largs Gaslight Company have paid the customary dividend of 6 per cent. for the past year. The Cumnock Gaslight Company have declared the usual dividend of 5 per cent., and continued the price of gas at 4s. 2d. per 1000 cubic feet. At the annual meeting of the Cambuslang Gas Company, the Directors reported that the net balance for appropriation was £1404; and they recommended that £960 be set apart for payment of a dividend of 8 per cent., that £240 be distributed as a bonus of 2 per cent., that £100 be placed to the reserve fund, and that the balance of £104 be carried forward to the succeeding year. They also recommended that the price of gas be reduced from 3s. 6½d. to 3s. 4d. per 1000 cubic feet. These proposals were adopted. The Bothwell and Uddingston Gas Company have declared a dividend at the rate of 10 per cent. for the past year. The shareholders have authorized the creation of £2250 of additional capital, in £1 shares. The newly-constructed Gas Company at Earlston (Berwickshire) have paid a dividend at the rate of 6¾ per cent. The Muirkirk (Ayrshire) Gaslight Company have paid a dividend at the rate of 4 per cent.

A new gasholder which has been erected at the Auchtermuchty Gas Company's works, was inaugurated on Thursday. The gas was turned on by Mrs. Walker, the wife of one of the Directors. Thereafter the Chairman of the Company (Mr. C. J. Simpson) entertained the company to cake and wine. Messrs. H. Balfour and Co., Limited, of Leven, were the contractors.

The post of Manager of the Stirling Gas Company is vacant through the resignation of Mr. Peter Watson. Sixty-six applications for the situation have been received; and the Directors have reduced the list to eight, which they are now considering.

Mr. J. M'Gilchrist, of Dumbarton, has been employed to value the undertakings of the Kirkcaldy and Helensburgh Gas Companies, in both of which places there are proposals for the Corporation taking over the works.

At the last meeting of the Dunfermline Town Council, Provost Walker said that they took over the Gas Company's undertaking as at May 31, 1896; and under the Burghs Gas Supply Act, they were obliged to close their financial year at May 15. They were then about a fortnight short of a complete year; otherwise their profits might have been greater, probably to the extent of about £100. Then for eight months they had to pay the shareholders of the Gas Company interest at the rate of 4 per cent. on the purchase price, which entailed an expenditure of about £600. In addition, they had to pay the bank for a time interest at a rate slightly above 3 per cent. Taking all these things into account, he thought that the expenditure they had last year, in excess of what they might expect to have in any ordinary year, was not less than £750. The net profit for the year was £1742. If they added the £750, they would have had a profit of nearly £2500 after paying 3 per cent. interest on the purchase price. If this year were no worse than the last, they ought to have in hand at May 15, 1898, at least £4000. He would suggest that this £4000 should be kept as a reserve fund, to meet deficiencies which might arise in any future years. This amount would give them £600 a year for eight years, with which they could reduce the price of gas. At the end of the eighth year of contributing to the sinking fund, they would have paid off one-fifth of the purchase price, with the result that the interest would be £600 a year less. He hoped that before this time arrived, they would have another and a considerable reduction in the price. He thought they had every reason to be gratified with the outcome of their first year's trading, and to congratulate themselves upon acquiring the gas undertaking.

On Friday, the 8th inst., there was a Jubilee cake and wine banquet given by the Provost of Greenock to the members of the Town Council and other public citizens. One of the guests was Bailie M'Innes, who was last year the Convener of the Gas Trust; and to him was allotted the toast of "The Town and Trade of Greenock." In supporting it, he said that the Corporation gas-works were small at the commencement of the "Record Reign," as compared with their condition in the present year. The price paid for gas was 11s. 3d. per 1000 cubic feet, whereas it is now only 3s., and there is no charge in the shape of meter hire, while there is some prospect that the price of gas will be still further reduced for the ensuing year.

It has been announced that the accounts of the Greenock Water Trust for the year ending May 26 last, which have just been made up, show that the income was £19,488, and the expenditure £19,393, leaving a surplus of £95. A movement is on foot to establish an aluminium rolling-mill in the vicinity of Baker Street; and the Water Trust have been asked to say what water-rate concessions they are prepared to give in the event of a company being formed to work the concern.

The annual inspection of the works for the supply of water to the city of Glasgow has been made by the Corporation. It is a two days' function, and is the most splendid affair of the kind in Scotland. Unlike their smaller brethren, they wisely make it altogether private; and what after-dinner oratory may be indulged in is not thrust upon the reading public. This year's duties included the inspection of the new reservoir at Craigmaddie, and the new works in the Blane and Endrich valleys, and at Loch Vennachar and Loch Katrine. One of the works which were special to this year was the boring of a tunnel at Loch Katrine, in the last of the pipe-line contracts of the scheme for the doubling of the water supply. The party drove on the 10th inst. by Craigmaddie and Aberfoyle to Callander, where they stayed over night; and the next day they drove by Loch Katrine to Inversnaid, whence they sailed down Loch Lomond, and took train from Balloch to Glasgow. Everything connected with the inspection passed off safely and satisfactorily. A start is to be made this summer with the outlet works at the lower end of Loch Katrine. These works include the building of a new masonry dam, by means of which the level of the water in Loch Katrine will be raised 5 feet above its present top-water level. This will bring up the storage capacity of the loch to 9849 million gallons, which, it is estimated, will enable it to yield a supply of 65 million gallons per day. The level of Loch Arklet is also to be raised till it is 25 feet above its present level; and a tunnel will connect it with Loch Katrine. This extra source will increase the supply to the city to 75 million gallons per day.

In the Court of Session, Lord Pearson has refused to grant the interdict, which was asked by the Clippens Oil Company, to restrain the Edinburgh and District Water Trustees from laying a loop line of piping in a public road which runs through the Company's mineral field at Pentland. The action of the Trustees was taken on account of their not being able to come to terms with the Company for the purchase of the minerals through which the pipe passes. The new pipe, it was stated, had been already laid. In a counter-application, in which the Water Trustees seek to interdict the Oil Company from working the minerals from below their pipes, or within 40 yards of them, Lord Pearson has allowed a proof.

English Incandescent Gas Share Company, Limited.—At the second annual general meeting of this Company next Friday, the Directors will report a total of £77,577 accruing to the Company from various sources in the year ending June 16 last. An interim dividend of 5 per cent. has been paid, amounting to £24,742; and the Directors will recommend a final dividend of 10 per cent., free of income-tax. This will absorb £49,531, and leave £3304 to be carried forward. Though the dividend for the year is 15 per cent., as against 20 per cent. last year, the Directors point out that the Incandescent Gas-Light Company, Limited, have this year carried forward £52,003, which practically belongs to the English Company, and represents a further 10 per cent. on the capital, and they express the opinion that such a solid reserve will materially increase the value of the shares and improve the position of both undertakings.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *June* 26.

Sulphate of Ammonia.—The business of the week has been rather of a holiday character; but prices have been about maintained. Closing quotations are £7 8s. 9d. to £7 10s. per ton f.o.b. Hull and Leith, and £7 12s. 6d. per ton f.o.b. Liverpool. Attention is still mainly directed to the forward position; but sellers' and buyers' ideas being somewhat divergent, no important business has been reported. There would probably be buyers at spot prices up to the end of the year; but business on this level does not commend itself to sellers.

LONDON, *June* 26.

Tar Products.—The tedium has at last been relieved by a movement in benzols; and business for forward delivery has been done at 2s. for 90 per cent. and 2s. 2d. for 50/90—a prompt and important advance, which makers are justified in accepting as the forecast to further rises from the slump into which benzols had unaccountably so suddenly descended. About pitch there is little to say; but, judging from the prolonged stay at present prices, the prospects are all in favour of a rise. Creosote and oils are in excellent demand; and, owing to the low state of the stocks, high prices are available. Carbolic is also firm for the same reason, and may probably advance in value. The sanguine tar distiller, carried away by his hopes for the future, continues to bid a value for tar which the present prices of products scarcely warrant; but his estimate may, after all, not be far wrong.

The following are the average prices obtaining: Tar, 15s. 6d. to 20s. Pitch, 18s. to 22s. Benzols, 90 per cent., 2s.; 50/90, 2s. 2d. Toluol, 2s. 4d. Solvent naphtha, 1s. 6d.; crude 30 per cent. naphtha, 11d. Creosote, 1¼d.; liquid, 2¼d. Heavy oils, 40s. to 45s. Carbolic acid, 60's, 2s. Pressed naphthalene, 60s. Salts, 25s. Anthracene, "A," 8d.; "B," 5½d.

Sulphate of Ammonia.—The improvement is maintained; and prices range from £7 10s. to £7 12s. 6d, less 3½ per cent.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—Business in the coal trade here has been more or less disorganized during the week, owing to the Jubilee celebrations, and consequent stoppages of pits and works. The lower qualities of round coal have been moving off slowly; but prices remain nominally unchanged. Engine fuel maintains a firm tone; and though at present supplies are by no means scarce, there is a general belief that prices will show an upward movement as the summer advances. At the pit mouth, best Wigan Arley averages 10s. per ton; Pemberton four-feet and seconds Arley, 8s. to 8s. 6d.; common house coal, 6s. 6d. to 7s.; steam and forge coal, 6s. to 6s. 6d.; and engine fuel, 4s. 6d. to 5s. for best sorts, 3s. 9d. to 4s. 3d. for medium, and 3s. 3d. to 3s. 6d. for common slack. Not more than a moderate inquiry comes forward in the shipping trade; the position remaining without material change, with steam coals averaging about 7s. 9d. to 8s. 3d. per ton delivered at the ports on the Mersey.

Northern Coal Trade.—There has been a better demand for coal generally since the resumption of working after the holidays; stocks having been depleted, and the production having been reduced. Prices of coal have thus been firmer, and there is a steady inquiry; while for some kinds of fuel there is an increased sale. Best Northumbrian steam coals are firm at 8s. 6d. per ton f.o.b.; second-class steam are quoted at 8s. 0d.; and steam smalls vary from 3s. 6d. to 3s. 9d. Gas coals are firmer; and now that June is near its close, it must be expected that there will be an increased demand. The possibilities of labour movements make coalowners incline to ask higher prices, so that the quotation is now firm at from 6s. 9d. to 7s. 3d. per ton f.o.b. for best Durham gas coals; and in one or two instances producers who are well sold ask higher rates. The large Teesside contract for gas coals is expected to go to the same range of collieries who have previously had it. Manufacturing coals are very brisk, without much change in quotation. Gas coke shows no alteration in price this week; but stocks are lower.

Scotch Coal Trade.—The demand, particularly for ell for shipment to Mediterranean and Baltic ports, continues good. Prices for all sorts are tending to firmness; but probably this was the result of the broken time of last week, when the miners were not working. The prices quoted are: Main, 6s. to 6s. 3d. per ton f.o.b. Glasgow; ell, 7s. to 7s. 6d.; and splint, 6s. 6d. to 6s. 9d. The shipments for the week amounted to 150,879 tons—a decrease of 10,024 tons on the previous week, and of 18,019 tons as compared with the corresponding week of last year. For the year to date, the total shipments have been 3,476,956 tons—an increase over the same period of last year of 77,400 tons.

Gas and Electric Lighting at Exeter.—The Exeter City Council, at a meeting last Wednesday, settled the question (for the present at least) of the public lighting of the city. Some of the central thoroughfares are to be lighted by electric arc lamps, of which there are to be 33, placed at irregular distances; the average being 73 yards. From one of the present arc light machines 22 of the lamps are to be run; and the remaining 11 from the alternator. In order to carry out the scheme, all the arc lamps now in use in the city will have to be altered from the direct to the alternating system. It is intended that the 11 lamps on the alternating system shall be kept burning during the usual hours of lighting; but the 22 on the direct current will be extinguished at midnight, and their place taken by two incandescent lamps on each post, so as to allow of only one machine being worked during the night. The cost of the installation is estimated at £1650; but no statement was made as to the cost of the light. The adoption of the electric light will release a number of large gas-lamps now in the principal streets; and these are to be removed to neighbouring thoroughfares. The Council decided to enter into a new contract with the Gas Company in regard to streets not included in the area to be lighted by electricity. The contract is to run for seven years from Michaelmas next, but is to be determinable at three or five years upon giving six months' notice.

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An Illustrated Advertisement of the Plant will appear next week.

Gosport Water Supply.—The Gosport Water-Works Company are making an important addition to their supplying capabilities by putting down new works at Foxbury, which will give them a further 1,800,000 gallons a day. The works are not yet complete; but they are so far advanced that the Directors have been able to augment therefrom the present supply—thus avoiding the trouble which has been experienced during previous summers.

Newport (Mon.) Water-Works.—At a recent meeting of the Newport County Council, Alderman Parnall, the Chairman of the Finance Committee, made the gratifying announcement that the water-rents now amounted to £20,000 a year, against £13,000 when the water undertaking was acquired. The water-rents had not only been sufficient to pay interest and the amount for redemption of principal, but the sum of £95,149 already expended on the Wentwood water scheme had also been provided for out of the income. Consequently, up to the present time, the actual cost of the Wentwood scheme to the ratepayers had been practically nothing.

New Joint-Stock Companies.—The following joint-stock Companies have lately been registered: Pitlochry Gaslight Company, Limited, with a capital of £5000, in £1 shares. River Plate Gas Company, Limited, with a capital of £1,500,000, in £10 shares, to acquire gas and electric light works in the River Plate and other countries in South America or any other part of the world. The Mantleless Incandescent Gas Corporation, Limited, with a capital of £150,000, in £1 shares, to adopt and carry into effect an agreement made between F. Rowan and E. Hard, and to carry on business as manufacturers of, and dealers in, lamps, burners, glasses, shades, and all materials, apparatus, appliances, and things used in connection with gas lighting. The Kent Coal, Finance, and Development Company, Limited, with a capital of £250,000, in £1 shares, to prospect and explore for coal in Kent or elsewhere in the United Kingdom. Tubes (America), Limited, with a capital of £400,000, in £1 shares, is to acquire the businesses of the Ellwood Weldless Tube Company and the Greenville Tube Company, of Pennsylvania, and the Weldless Steel Tube Company, of Ohio.

Projected Improvements in the Cardiff Water Distribution System.—The Cardiff-Water-Works Engineer (Mr. C. H. Priestley) has made a report to the Corporation Water Committee on the supply of Penarth, in relation to which complaints have been made. Mr. Priestley said the complaints of the consumers were fully borne out by experiments he had made. In the day, and especially when the streets were being watered, there was an insufficient pressure; thus proving the inadequacy of the existing mains. He therefore recommended that new trunk mains should be laid from Llandough, where additional power is needed to pump the water into the reservoir. In his estimate, he took into consideration future requirements. The cost would be about £5000; and the Committee decided to expend about half this amount on work which would meet the present demands. It was stated that to obviate the necessity of pumping at Llandough, a high-pressure main would have to be laid from Rhubina. This would, roughly speaking, entail a cost of £10,000; and it was stated that the idea was to undertake the work when the consumption merited the expenditure.

The New Water Supply for Crowborough.—The report of the Clinical Research Association, Limited, on the water recently found at the Warren, Crowborough, has been received by Mr. C. Dawson, F.G.S., under whose advice the engineers have been working. It states that it is a water of quite exceptional purity, very soft; and that the mineral matters in solution are both small in amount and of a satisfactory nature. After clearing, it will be an admirable water for a domestic supply.

A Water Scheme for Bedworth.—The Foleshill Rural District Council are contemplating the carrying out of a scheme of water supply for Bedworth, which has a population of 6000. The sum required for the works is £8775; and for this application has been made to the Local Government Board. The well from which the supply is to be taken yields 210,000 gallons a day, or more than double the requirements of the town, presuming that the consumption averaged 15 gallons per head per day.

Exeter Corporation Water-Works.—At a recent meeting of the Exeter City Council, the Water Committee submitted their annual statement of accounts. The estimated profit from the undertaking was £1000; but the actual surplus was £1663. The Committee recommended that the sum set aside for depreciation should be increased from £100 to £200, and that the balance of £1463 should be carried to the credit of the general district rate. The increased profit was due to a reduction of expenditure, the income being only £36 more than in the previous year. In consequence of no special work such as that occasioned by the severe frost of 1895 having been necessary, the weekly wages had decreased by £175; a saving of £54 had been made on coal; and £130 upon general repairs. The Committee recommended that in future the sum of £200 instead of £100 should be set aside for depreciation. They also reported that the Surveyor is proceeding with the detailed plan of the scheme of extension of the works, for which the Local Government Board are to be asked to sanction a loan of £25,000. The report was adopted; an amendment to restrict the payment of an additional £100 for depreciation to this one year being defeated.

The Bacteriological Examination of London Water.—In their last report to the Official Water Examiner for the Metropolis (Major-General A. De Courcy Scott, R.E.) on the composition and quality of daily samples of the water supplied to London in the month of May, Professors Crookes and Dewar state that, instead of, as formerly, examining bacteriologically each water supply once a fortnight, they now examine samples from each supply daily. This is, therefore, a much more severe test of the adequate nature of the filtration from day to day; and the mean results of their microbial estimations cannot properly compare with results obtained at periods of a fortnight apart. Further, the samples they collect from the clear-water wells of the Companies are immediately cooled to the temperature of melting ice. This temperature is maintained till the plate cultivation is commenced, not later than five hours afterwards, and it is continued at 21° C., for 48 hours, when the colonies are counted. Such a severe examination of the process of filtration at once enables them to warn the Companies if any of the filter-beds are working abnormally; and already they are in a position to state that the average bacteriological quality of all the London waters has been greatly improved since the commencement of the present year.

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The Driffield District Council and the Gas-Works.—The Driffield District Council enter into possession of the gas-works to-morrow; but they are commencing business in anything but a business-like way. They propose to continue the price of gas at 2s. 11d. per 1000 cubic feet until Oct. 1, after which date it will be raised to 3s. 4d. At the last meeting of the Council, three of the members protested against this increase, as, they very sensibly urged, it would tend to lessen the consumption. On the other hand, the Chairman (Mr. Luke White) remarked that, if the price of gas was not increased, then the rate they had lately laid ought to have been 4d. higher; and they had decided that the ratepayers and consumers should jointly bear the burden. The proposal was agreed to; but the Council appear to have overlooked the fact that there are other means of lighting available, and that the consumers may refuse to burn gas that is 5d. dearer than the price they have been paying to the Company.

Gas Affairs at Port Elizabeth.—The Manager of the South African Lighting Association (Mr. W. Arnott) has lately been showing the inhabitants of Port Elizabeth what can be done by incandescent gas-lights in improving public lighting. His efforts were at first confined to Main Street, over the whole length of which the new lights, according to a local paper, "shed a flood of brilliancy;" and they have been so successful that similar lights are to be put up in other parts of the town. "Projector" lights have also been put up in front of the Town Hall and elsewhere, and have given much satisfaction. It is thought that these improved lights will, in the near future, be used in almost every thoroughfare in the town. Under these circumstances, Mr. Arnott was justified, on the occasion of the second annual entertainment given to the men (which, by the way, was a very successful and enjoyable gathering), in stating, in reference to the advent of electric lighting in Port Elizabeth, that the Association had nothing to fear as to competition from that quarter, as it had been shown, in the experience of every town where it had been introduced, that the consumption of gas had in all cases increased. Now, with the incandescent gas-light, they had material in their hands which, light for light, had been proved to be only one-eighth the cost of electric light. He added that, so little did they fear competition that they were now spending something like £10,000 upon additional plant, in order to be in a position to meet the increased demand for gas. He trusted all the men would do their utmost to work for the best interests of the Association and the public.

Water-Works for Winscombe.—Mr. W. O. E. Meade King has recently been engaged at Winscombe in receiving evidence, on behalf of the Local Government Board, in regard to an application by the Rural District Council of Axbridge for power to borrow £2400 for works of water supply. The source of the proposed supply is in the Winterhead Valley, Shipham; the yield and quality of the water being all that could be desired. There was a little opposition from Shipham.

The Davis Gas-Stove Company, Limited, have recently been exhibiting at Sunbury, with Miss A. C. Wilkinson as the exponent of the art of cooking by gas.

The British Lens and Glass Company, Limited, who manufacture the new Loftus patent street-lamps, in which compound curved panes of glass are used, have acquired works at Coalbourn Hill, Stourbridge; and Messrs. Baxendale and Co., of Manchester, are the licensees. It is claimed that the formation of the panes in these lamps ensures a perfectly lighted path.

At a very successful exhibition organized by Mr. G. Lane, the Manager of the Aylesbury Gas Company, and held in that town from the 15th to the 18th ult., the Davis Gas-Stove Company, Limited, showed their "Metropolitan" and other stoves; Messrs. Thomas Glover and Co. their "penny-in-the-slot" meters; and the Denayrouze burner was on view. Miss Aimée Richards gave lectures on cookery.

Messrs. Bartlett, Hayward, and Co., of Baltimore, have been entrusted by the Pawtucket Gas Company with the erection of a steel gasholder, which, it is believed, will be the largest in the State of Rhode Island. The inner lift is to be 110 feet, and the outer lift 112 feet in diameter; each being 27 feet deep. The holder is to work in a steel tank 114 ft. 6 in. diameter and 27 ft. 6 in. deep; and its capacity will be rather more than 500,000 cubic feet.

Messrs. James Milne and Son, Limited, finding their premises at 48, Wellington Street, Leeds, inadequate, have opened workshops in Holbeck Lane, which will be known as the Midland Meter-Works. They have been fitted up solely for the manufacture and repair of meters and other gas apparatus; and they will be under the personal supervision of Mr. W. D. Helps, Messrs. Milne's Leeds Manager. The Wellington Street works will still be retained for office and warehouse purposes.

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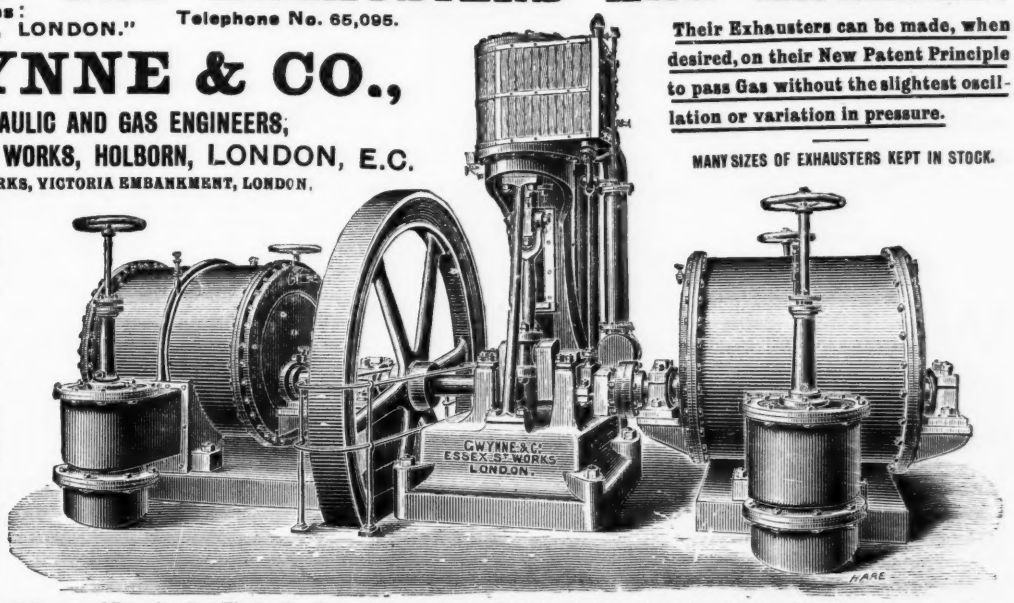

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[For Illustrated Advertisement, see June 22, p. 1454.]

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WANTED, by a steady, experienced FITTER, a Situation in Gas-Works. Thoroughly experienced in Mains, Services, Slot Meters, Stoves, and General Fitting, Reading Meters, &c. First-Class Testimonials.
Address No. 2864, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

GENTLEMAN, Engineer and Draughtsman thoroughly experienced in the technique of Gas-Works, wants Situation as London Representative, Traveller, or Quantity Taker. Can advise on Extensions or Repairs, and arrange New Plant.
Address No. 2871, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

APPOINTMENT wanted by a young Married Man. Well up in details of all Gas Plant and Constructional Ironwork. Eight Years' Experience at well-known Gas Plant Manufacturers and Gas-Works. Excellent Testimonials. No objection to going abroad.
Address No. 2870, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, Retort Setters and Bricklayers.
Apply to R. DEMPSTER AND SONS, LIMITED, Elland, YORKS.

HINCKLEY URBAN DISTRICT COUNCIL.
(GAS DEPARTMENT.)
WANTED, as Leading Stoker, a reliable Man.
Apply to G. HELPS, Gas-Works, HINCKLEY.

GAS-FITTER wanted, as leading hand, for Lead and Iron Pipes, fixing and repairing Meters, Gas-Cookers, &c.
Address, stating Age, Experience, and Wages required to Mr. BRADDOCK, Manager, Gas-Works, RADCLIFFE.

WANTED, a leading Draughtsman by a Firm of Contracting Gas Engineers. Permanent Situation.
Apply, stating Age, Experience, and Salary, to No. 2867, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WORKING Manager required for small Gas-Works using Iron Retorts. Competent to undertake small Repairs. Wages, 25s. per week.
Apply, by letter, stating Age and Particulars as to Qualifications, to SAMUEL COURTAULD & Co., LIMITED, Braintree, ESSEX.

ALTRINCHAM GAS COMPANY.
WANTED, a Retort-House Foreman for Night Duty. Must be a thoroughly experienced and steady Man, and under 40 Years of Age. Wages £2 per week.
Apply, by letter, stating Age, previous Experience, and full Particulars, not later than Twelve noon, the 8th of July next.
J. E. LAMB,
Manager.
Gas Offices, Altrincham,
June 24, 1897.

SADLER & Co., Ld., Middlesbrough; ULVERSTON (BARROW); PORTSMOUTH; CARLTON (N.E.R.); and STOCKTON. Tar and Petroleum Distillers. Benzol and Petroleum Spirit, 700 and other Gravities specially prepared for Carburetting. SOLAR OIL for Gas Making, Kerosene, &c.
Correspondence invited.
Telegraphic Address: "Sadler, Middlesbrough."

NEW GAS PLANT CEMENT.
JOHN E. WILLIAMS AND CO.,
VICTORIA PAINT WORKS,
MANCHESTER.
For all Joints in connection with Oil-Gas Plant and Sulphate Plant.
For all Gas Joints.
For all Tar Joints.
For all Ammonia Joints.

SULPHATE OF AMMONIA SATURATORS.
WALTER THOMASON and SONS, Chemical Plumbers, &c., and Makers of Lead Saturators, &c., 21, WESTON STREET, BOLTON. Repairs of every description.
Please write for Estimate before ordering elsewhere.

ALEX. P. KER, C.E., Consulting Gas Engineer, Hunton Road, Grave'y Hill, Birmingham, 25 Years Assistant Engineer and Manager of Works to the Corporation of Birmingham and their predecessors, MAY BE CONSULTED on all matters connected with GAS ENGINEERING, including Valuations, Alterations, Additions and Extensions, &c. REPORTS upon EXISTING WORKS and IN PROGRESS. EXAMINATIONS OF GAS for ILLUMINATING POWER and IMPURITIES conducted. Plans, Specifications, and Estimates prepared.

WANTED, in a Midland Town, a Main and LEAD SERVICE LAYER of experience, and capable of undertaking the management of Men.
Apply, stating Age and Wages required, with References as to Character, Sobriety, &c., to No. 2869, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

DRAUGHTSMAN required by Messrs. Cutler, accustomed to Gas or General Engineering. Permanent Situation to satisfactory Man. State Age, previous Experience, Wages required, &c.
Also vacancy for an intelligent JUNIOR.
Address, S. CUTLER AND SONS, Millwall, LONDON.

WANTED, at a Provincial Gas-Works, a RETORT-HOUSE FOREMAN. Must be under 40. One having knowledge of Carburetted Water-Gas Manufacture preferred. *Copies* of Characters only to be forwarded. Wages £2 per week.
Apply, by letter, to No. 2866, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

ARUNDEL GAS COMPANY.
WANTED, a respectable and experienced MAN (not over 33) to lay Mains and Service-Pipes, fix Meters and Gas Apparatus Fittings, attend to the Purifiers, and make himself generally useful. Annual make about 15 Millions. None except strictly sober and competent men need apply. Married Man preferred.
Apply at once, stating Age and Wages required, and enclosing References, or *copies* of Testimonials (which will not be returned), to W. C. DAWSON, Manager, Gas-Works, Arundel, SUSSEX.

GAS CARBON Wanted, not less than 4-Ton Loads.
Apply to the BRIMINGTON CARBON COMPANY, Sowerby Bridge, YORKS.

WANTED, a Second-Hand Purifier, about 8 ft. by 6 ft., or 6 ft. by 6 ft. Must be in good working condition.
Address No. 2868, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, to purchase Gas Carbon delivered at nearest Station to Gas-Works, in quantities of not less than 4 tons.
Address, stating Price per ton and quantity, No. 2772, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

VERY pure and faultless Thorium, with considerable Lighting Power, can be supplied regularly on very Moderate Terms.
Address J.Y. 6935, care of Rudolf Mosse, BERLIN, S.W.

FOR SALE—350 to 400 Tons of Pitch. Good, Medium, Soft Quality. Made from English Coal Tar Distillation.
Apply Messrs. R. W. GOOLD AND Co., 32, English Street, CARLISLE.

FOR SALE—A Station Meter complete, in thorough working order. Recently overhauled and certified correct by Messrs. Braddock. Capacity, 50,000 feet per hour.
Apply to JOHN H. DARBY, Brymbo, near WREXHAM.

STEAM-ENGINE, 30 Brake Horse Power (complete with Stand, Driving-Belt, &c.), FOR SALE. Only Six Years in use. To be put aside for a 70-Horse POWER ENGINE to meet growing requirements.
Can be seen running now at ALDER AND MACKAY'S, Gas-Meter Works, Stewart Terrace, EDINBURGH.

CANNEL, COAL, ETC.
JOHN ROMANS & SON, EDINBURGH, Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS and WATER WORKS.
Prices, &c., will be forwarded on application to No. 80, ST. ANDREW SQUARE, EDINBURGH, / NEWTON GRANGE, NEWBATTLE, DALKEITH, } SCOTLAND.

TO GAS AND WATER OFFICIALS.
SPECIAL and Favourable Terms for CYCLES are offered. The very best "up-to-date" Cycle at a reasonable Cost. "Dunlop" Tyres, Weldless Tube throughout, "Westwood" Rims, "Brook's" Saddle, "Perry's" or "Renold's" Chain, &c. The whole combining to make as fine a Machine as is possible to be made. Satisfaction guaranteed. Send at once for Catalogue post free.
MELROSE CYCLE COMPANY, COVENTRY.

ECONOMY IN PURIFICATION.
INCREASE the Efficiency of your PURIFIERS by adopting CRIPPS'S PATENT BYE-PASS VALVE in the lower Tiers of Sieves. Practical Experience proves their Economy. Engineers are repeating orders after thorough trial.
References and Particulars can be obtained from the Makers—
C. & W. WALKER, Midland Iron-Works, Donnington, near Newport, SALOP.
And J. EVERY & SON, Phœnix Iron-Works, LEWES.

WORKSHOP ACCOUNTS — Factory, Job, and Contract Book-Keeping. To Contractors, Foremen, Clerks, and Master Men. Save yourselves Trouble and Worry. Send at once for HARDING'S GUIDE TO PRIME COST. Lifetime's Labour concentrated. *Post Free*, 1s. 0½d.
L. G. HARDING, 605, Manchester Road, POPLAR, E.

GAS PLANT for Sale—I can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also COMPLETE WORKS equal to 7000, 20,000, 60,000 cubic feet per diem. **Inquire and compare Prices and Particulars before ordering elsewhere.**
J. F. BLAKELEY, Gas Engineer, Ravensthorpe, YORKS.

BOROUGH OF NEWBURY.
(GAS DEPARTMENT.)
THE Gas Committee of the Newbury Corporation invite TENDERS for the supp'y of 2600 Tons of best GAS COAL during the Eleven Months ending June 30, 1898.
Delivery to be free to Newbury Railway Station.
All tenders, to be endorsed "Tender for Coal," are to be addressed to the Chairman of the Gas Committee, Gas-Works Office, Newbury, and posted not later than the 10th prox.
No Forms of Tender are issued; and the lowest or any tender will not necessarily be accepted.
ROBERT M. COUPER,
Manager.
Gas-Works, Newbury,
June 25, 1897.

STOURBRIDGE GAS-WORKS.
TENDERS FOR GAS COAL.
THE Gas Committee of the Urban District Council of Stourbridge invite TENDERS for the supply of 10,000 Tons of GAS COAL, for delivery over the Year ending June 30, 1898.
Forms of Tender may be obtained from the undersigned.
Sealed tenders, endorsed "Tender for Gas Coal," to be addressed to the Chairman of the Gas Committee, and delivered to the undersigned on or before July 12, 1897.
By order,
WM. NORTH,
Engineer and Manager.
Gas-Works, Stourbridge,
June 19, 1897.

TO GASHOLDER AND PURIFIER MAKERS.
THE Town Commissioners of Cashel, County Tipperary, Ireland, invite TENDERS for the erection of a new TWO-LIFT TELESCOPE GASHOLDER (counter-balance), to be placed in a Stone Tank already erected.
Also two new PURIFIERS, 5 ft. by 4 ft., with the necessary Connections, Valves, and Lifting Gear.
Also the RE-LAYING of MAINS on Works.
Plans and Specifications to be seen at the Town Hall, Cashel.
Sealed tenders, to be addressed to the Town Clerk, Cashel, County Tipperary, Ireland, and endorsed "Tender for Gasholder, &c.," will be received by the undersigned not later than Twelve o'clock noon, on the 5th of July, 1897.
The Contractor will be obliged to enter into a Bond with two solvent sureties for the due completion of Contract, to the satisfaction of the Engineer appointed by the Board.
Anyone requiring Plan and Specification must apply personally, and check all Measurements in the Specification.
The Commissioners do not bind themselves to accept the lowest or any tender.
By order,
JOHN O'LEARY,
Town Clerk, &c.
Town Hall, Cashel,
June 18, 1897.

RADCLIFFE AND PILKINGTON GAS COMPANY.

TENDERS FOR COAL AND CANNEL.

THE Directors of the Radcliffe and Pilkington Gas Company invite TENDERS for about 10,000 Tons of GAS COAL and CANNEL.

Particulars may be obtained from the undersigned, to whom Tenders, properly endorsed, must be delivered on or before Friday, the 2nd of July.

JAMES BRADDOCK,
Manager and Secretary.

Gas Offices, Radcliffe,
June 16, 1897.

DISTRICT OF NEWTON-IN-MAKERFIELD.

THE Gas Committee of the above Council invite TENDERS for the supply and erection of four PURIFIERS, each 20 feet square, with Centre-Valve and Connections according to the terms of a Specification, which may be seen on application at my Office, where Tenders with Drawings of same may be delivered, endorsed "Purifiers," not later than Saturday, the 3rd of July next.

The lowest tender will not necessarily be accepted.

RICH. BRIERLEY,
Engineer and Surveyor.

Town Hall, Earlestown,
June 18, 1897.

WORKSOP GAS COMPANY.

THE Directors of the Worksop Gas Company are prepared to receive TENDERS for the supply of 3500 Tons of the best screened GAS COAL, to be delivered at Worksop Station during the Year ending the 31st of July, 1898.

Tenders to be sent in to the undersigned on or before the 10th of July, 1897.

The Directors reserve to themselves the right to accept tenders for the whole, or any portion of the quantity offered, and do not bind themselves to accept the lowest or any tender.

F. KENT,
Manager.

LEIGH URBAN DISTRICT COUNCIL.

THE Gas Committee of the Leigh Urban District Council invite TENDERS for the supply of 10,000 Tons of GAS COAL and 700 Tons of CANNEL for the Year ending the 30th of June, 1898.

Specifications, with Tender Forms and all Particulars, may be obtained from the undersigned.

Sealed tenders, endorsed "Coal" or "Cannel," and addressed to the Chairman of the Gas Committee, to be delivered at the Town Hall, Leigh, not later than Ten a.m., Monday, the 12th of July next.

The lowest or any tender not necessarily accepted.

THOMAS DICKINSON.

Gas-Works, Leigh,
June 26, 1897.

TENDERS FOR GAS COAL.

THE Directors of the Westerham Gas and Coke Company, Limited, invite TENDERS for a Year's supply of about 450 Tons of the best screened GAS COAL delivered at Westerham Station, in quantities of about 50 Tons, to suit the convenience of the Directors.

Tenders, stating the description, and endorsed "Tender for Coal," to be sent to the Office of the Company on or before Wednesday, the 7th of July, 1897.

The Directors do not bind themselves to accept the lowest or any tender.

By order,
CHARLES HOOKER,
Secretary and Manager.

Westerham, Kent.

N.B.—No Tender Forms supplied by the Company.

OLDHAM CORPORATION WATER-WORKS.

ROODEN RESERVOIR—IRONWORK, VALVES, &c.

THE Water-Works Committee are prepared to receive TENDERS for the supply of IRONWORK, VALVES, &c., required in the construction of this Reservoir.

The Specification and Forms of Tender may be obtained and Drawings may be seen at the Offices of Messrs. G. H. Hill and Sons, 3, Victoria Street, Westminster, and Albert Chambers, Albert Square, Manchester, on payment of one guinea.

Sealed tenders, endorsed "Tender for Ironwork, Valves, &c.," must be addressed to Mr. Arthur Andrew, Water-Works Offices, Oldham, on or before Tuesday, July 13, 1897.

The Committee do not bind themselves to accept the lowest or any tender.

By order,
A. NICHOLSON,
Town Clerk.

Town Hall, Oldham,
June 16, 1897.

CORPORATION OF ROTHERHAM.

TO BUILDERS AND CONTRACTORS.

THE Gas Committee of the above Corporation invite TENDERS for the following erections:—

A RETORT-HOUSE with IRON ROOF, a BENCH of SIX ARCHES complete with RETORTS and MOUNTINGS arranged on the Inclined System, and with REGENERATOR FIRING, and the usual CHARGING APPLIANCES, ELEVATING and CONVEYING MACHINERY, &c.; also a BOUNDARY WALL.

Drawings and Specifications may be seen at the Town Clerk's Office, Rotherham, on and after Wednesday, the 30th day of June, 1897.

Sealed tenders, endorsed "Tender for Retort-House, &c.," and addressed to me, must be sent in not later than Twelve o'clock at noon of July 7, 1897.

By order,
H. H. HICKMOTT,
Town Clerk.

Council Hall, Rotherham,
June 25, 1897.

BOROUGH OF BATLEY.

TENDERS FOR GAS COAL.

THE Corporation of Batley are prepared to receive TENDERS for the supply and delivery, at their Gas-Works, of 14,000 Tons of GAS COAL.

Conditions and Forms of Tender may be obtained on application to the Manager at the Gas-Works.

Sealed tenders, addressed to me, and endorsed "Gas Coal," to be delivered at my Office by Noon on Monday, the 12th of July next.

The Corporation do not bind themselves to accept the lowest or any tender, and may accept any tender for a part only of the specified quantity.

By order,
JOSEPH HANSON CRAIK,
Town Clerk.

Town Clerk's Office, Batley,
June 25, 1897.

STAINES RESERVOIRS JOINT COMMITTEE,

INCORPORATED BY ACT OF PARLIAMENT,
59 AND 60 VICT., CAP. 241.

ISSUE OF £250,000 £3 PER CENT. DEBENTURE STOCK.

Payment of Interest guaranteed by the three following Companies:—

The West Middlesex Water-Works Company,
The Grand Junction Water-Works Company, and
The New River Company,
jointly and severally.

NOTICE is Hereby Given, that the Joint Committee are prepared to receive TENDERS for the above ISSUE, being the first portion of the DEBENTURE STOCK created by the above Act, bearing Interest at 3 per cent. per annum, payable half yearly, and redeemable after the expiration of 25 Years from the date of issue, subject to Six Months' notice being given by the Committee.

Tenders must be delivered at the Office of the Committee, No. 19, Marylebone Road, N.W., not later than Two o'clock p.m., on Wednesday, the 21st July next.

Particulars and Conditions, together with Form of Tender, may be obtained at the said Office, or will be forwarded upon application; also of Messrs. Hollams, Sons, Coward, and Hawksley, Solicitors, 30, Mincing Lane, E.C.; and of Messrs. Prescott, Dimsdale, and Co., Limited, Bankers, 50, Cornhill, E.C.

By order of the Joint Committee,
F. H. WYBROO,
Secretary.

Office of the Committee:
19, Marylebone Road,
London, N.W., June 16, 1897.

THE GASLIGHT AND COKE COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS of this Company so far as they relate to the CAPITAL STOCKS WILL BE CLOSED at Four o'clock p.m., on Tuesday, the 6th day of July next, and will be RE-OPENED immediately after the Half-Yearly General Meeting of the Company, to be held on the 6th day of August next.

By order,
JOHN WILLIAM FIELD,
Secretary and General Manager.

Chief Office: Horseferry Road,
Westminster, S.W., June 25, 1897.

Price 6s., Cloth Bound,

THE CHEMISTRY OF ILLUMINATING GAS.

By N. H. HUMPHRYS, Assoc M.Inst.C.E., F.C.S.

This work contains chapters on: The Relative Cost of Light from Gas, Oil, and Candles; Products of Combustion; The Sulphur Question; The Composition of Illuminating Gas; Water Gas; Various Gas-Making Processes; Oil Gas; Properties of Fluid Hydrocarbons; Tar for Gas-Making; Destructive Distillation; Condensation; and Purification.

LONDON:
WALTER KING, 11, Bolt Court, Fleet Street, E.C.

THE "COOMBE" DRAUGHT SCREEN FOR INCANDESCENT BURNERS.

For Illustration and Statement of Advantages to be gained by its use, see "JOURNAL," June 1, p. 1271.

ALFRED ARCULUS & CO., Glass Manufacturers,
BIRMINGHAM.

HUNTER'S OXIDE OF IRON.

JAMES HUNTER, MINER AND SHIPPER OF NATURAL IRISH BOG ORE.

This Estate yields the finest and most uniform quality in Ireland; and the quality is guaranteed.

Samples and Prices on application.

5, PRINCES STREET, PORT GLASGOW.

Telegrams: "HUNTER, PORT GLASGOW."

Established 1872.

ISSUE OF STOCKS AND SHARES BY AUCTION UNDER PARLIAMENTARY POWERS.

MR. ALFRED RICHARDS undertakes the issuing by Auction of GAS AND WATER SHARES under Parliamentary Power.

He also holds MONTHLY SALES of GAS AND WATER SHARES at the Auction Mart, Tokenhouse Yard, E.C.

Terms for the issuing of Capital, and also for offering to auction Gas and Water Shares, and all Particulars relating thereto, may be had of Mr. Alfred Richards.

Offices: 18, FINSBURY CIRCUS, E.C.

By Order of the Directors of the

TOTTENHAM AND EDMONTON GASLIGHT AND COKE COMPANY.

SALE OF DEBENTURE STOCK.

MR. ALFRED RICHARDS will Sell by AUCTION, at the Mart, E.C., on Monday, July 5, at Two o'clock, in lots, £15,000 FOUR PER CENT. PERPETUAL DEBENTURE STOCK of the above Undertaking, offering to Trustees and others an Investment of the soundest character.

Particulars at the COMPANY'S OFFICES, TOTTENHAM; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C., and TOTTENHAM.

By Order of the Directors.

GUILDFORD GASLIGHT AND COKE COMPANY.

SALE OF £5000 STOCK.

MR. ALFRED RICHARDS will Sell by AUCTION, at the Mart, E.C., on Tuesday, July 6, at Two o'clock, in Lots, £5000 of ORDINARY STOCK in the Guildford Gaslight and Coke Company, ranking for a Standard Dividend of 5 per cent. per annum.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of Executors and other Owners.

GAS AND WATER STOCKS AND SHARES (DEBENTURE AND ORDINARY) IN THE

Lea Bridge District Gas Company.
Aldershot Gas and Water Company.
New Swindon Gas Company.
Uxbridge and Hillingdon Gas Company; Gaslight and Coke Company; Commercial Gas Company; Portsea Island Gas Company; Maldon Gas Company; Ilford Gaslight and Coke Company.

MR. ALFRED RICHARDS will Sell the above BY AUCTION, at the Mart, London, E.C., on Tuesday, July 6, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

HOLMSIDE GAS COALS.

PRESENT DAILY PRODUCE OVER 4000 TONS.

LATEST ANALYSIS—By CHARLES PHILLIPS, Gas Examiner to Rotherham Corporation.

Yield of Gas Per Ton . . 11,205 Cubic Feet.
Illuminating Power, 16 7/10 Stand. Sperm. Candl.
Coke (of good & pure quality) 13¾ Cwt. Per Ton.
Sulphur . . . . A little over 1 Per Cent.
Ash . . . . . Under 1 Per Cent.
Tar . . . . . 163 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 103 Lbs. (Avoir.) Per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR PELTON GAS COALS.

PRESENT DAILY PRODUCE AVAILABLE 2500 TONS.

RESULTS OF DIFFERENT ANALYSES:—

Yield of Gas Per Ton . . 10,500 Cubic Feet.
Illuminating Power . 17 Stand. Sperm Candl.
Coke (of excellent quality) . 13½ Cwt. Per Ton.
Sulphur . . . . . 1·13 Per Cent.
Ash. . . . . 1·34 Per Cent.
Tar. . . . . 180 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 94½ Lbs. (Avoir.) Per Ton.

The HOLMSIDE and SOUTH MOOR COALFIELD possesses *a very great quantity of the best Coal;* and, whilst other Coal-Fields are becoming exhausted, this one is only being opened out, so that *the quality* of both the HOLMSIDE COALS, and the SOUTH MOOR COALS *may be relied upon for all practical purposes.*

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,
HOLMSIDE AND SOUTH MOOR OFFICES,
NEWCASTLE-UPON-TYNE.

TROTTER, HAINES, & CORBETT,
Brettell's Estate
FIRE-CLAY & BRICK WORKS,
STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.

Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAY.

SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

LONDON OFFICE: R. CULL, 84, OLD BROAD ST., E.C.

ROBERT MARSHALL,
CANNEL COAL MERCHANT,
97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on Application.

E. ASQUITH & CO.,
Hydraulic Engineers,
17, Mather Street, Ancoats, Manchester,
Fit up Plants for
Pressing Anthracene, Naphthalene, &c.
Competent Men sent out to erect same. Estimates given.

NEWBATTLE CANNEL.
Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO
THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

UNEQUALLED.
Gas Companies are solicited to try Samples of the
MIRFIELD
BLACK BED GAS COAL.
Prices and Analysis on application.
MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

Lanemark Coal Co.,
LIMITED.
LANEMARK CANNEL
AND GAS COALS.
Quotations and Analysis on Application to
LANEMARK COLLIERY,
NEW CUMNOCK, N.B.
Shipping Ports: All the principal Scotch Ports.

COKE-BREAKERS,
PRICES REDUCED.
(THOMAS & SOMERVILLE'S PATENT)
New Design, with two Cutting Rollers, making less Breeze than their old pattern.
GEORGE WALLER & CO.,
165, QUEEN VICTORIA STREET, E.C.,
And at STROUD, GLOUCESTERSHIRE.

LONDONDERRY GAS COALS
FROM THE
MARQUIS OF LONDONDERRY'S COLLIERIES,
COUNTY OF DURHAM.
Available output up to 5000 tons per day.
Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by
Mr. John Pattinson, F.C.S., F.I.S.
FOR PRICES AND PARTICULARS, APPLY TO
S. J. DITCHFIELD,
SEAHAM HARBOUR, COUNTY OF DURHAM.

THE SILICA FIRE-BRICK COMPANY,
OUGHTIBRIDGE, near SHEFFIELD,
MANUFACTURE
SILICA BLOCKS, BRICKS, AND CEMENT
OF SUPERIOR QUALITY
FOR GAS-FURNACES.
Trade Mark: "SILICA."
These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their
GREATER DURABILITY,
Strongly recommended where EXCESSIVE HEATS have to be maintained.

THORNLEY GAS COALS
WORKED BY THE
WEARDALE IRON & COAL Co., Ld.
OUT OF THEIR
THORNLEY AND WHEATLEY HILL COLLIERIES.
Analysis made by
Messrs. J. & H. S. PATTINSON, *May 28, 1895.*

Yield of Gas per Ton . .	10,500 Cub. Ft.
Illuminating Power . .	16·9 Candles.
Coke (of good quality) . .	67·5 per Cent.
Sulphur	0·58 „
Ash	2·73 „

For Price, &c., apply to the
WEARDALE IRON & COAL Co., Ld.
QUAYSIDE, NEWCASTLE-ON-TYNE.

HEBBURN MAIN GAS COALS.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·4 candles.
Coke	68 per cent.

For Prices, f.o.b. Ship or Delivered by Rail, apply to
THE WALLSEND & HEBBURN COAL COMPANY, LTD.
8 Lombard Street,
NEWCASTLE-ON-TYNE.
W. RICHARDSON, Fitter.

THOMAS TURTON AND SONS, LIMITED,
SHEAF WORKS, SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACKS
ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.
LONDON OFFICE:
90, CANNON STREET, E.C.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887,
for
CANNEL & COAL.

TYNE
BOGHEAD CANNEL.

Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles.
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	17·8 candles.
Coke	70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	73·1 per cent.

For Prices and complete Analysis, apply to
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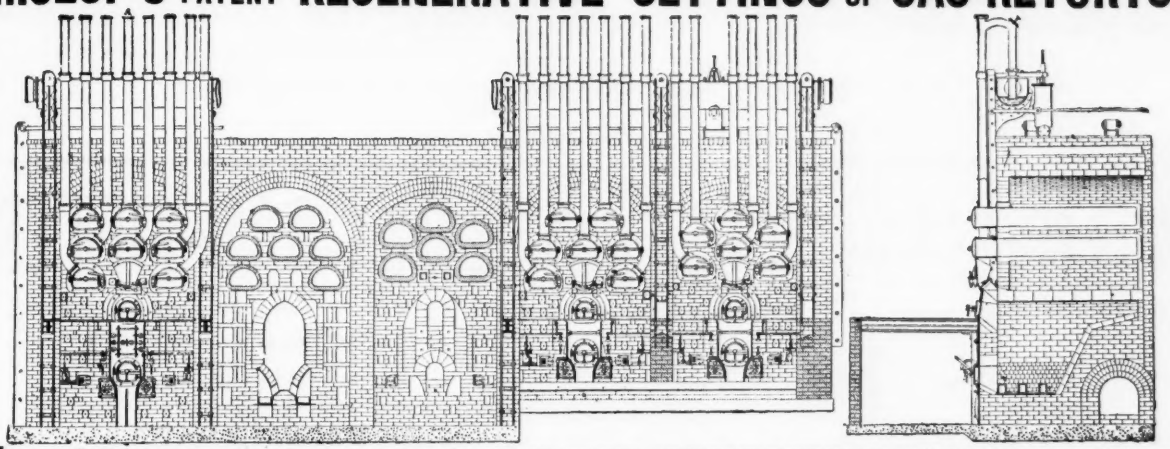
HISLOP'S PATENT REGENERATIVE SETTINGS OF GAS-RETORTS.



THESE SETTINGS ARE POSITIVELY UNRIVALLED IN PRODUCTIVE CAPACITY, DURABILITY, AND SIMPLICITY OF MANAGEMENT. RETORTS OF ORDINARY DIMENSIONS CARBONIZING FROM 17 TO 20 CWT. OF ENGLISH AND 20 TO 24 CWT. OF SCOTCH COAL PER 24 HOURS, DEPENDING UPON THE NATURE OF THE COAL, AND PRODUCING UP TO FULLY 13,000 CUBIC FEET PER MOUTHPIECE IN THE SAME TIME, AND WITH THE SMALLEST EXPENDITURE OF FUEL ATTAINABLE, AND RETURNING IN PROFIT THE ENTIRE COST OF ERECTION WITHIN TWELVE TO EIGHTEEN MONTHS; AND THUS REDUCING TO INSIGNIFICANCE THE INCREASED COST OF THESE SETTINGS OVER THE COMMON OR GENERATOR FURNACE SYSTEMS.

THESE SETTINGS ARE EXTENSIVELY ADOPTED, AND ARE ERECTED UPON THE SHALLOW AND STAGE FLOOR PLANS. THEY ARE ADAPTED TO ANY EXISTING ARRANGEMENTS, AND PERFECT SATISFACTION GUARANTEED. THE COMPOSITION OF FIRE-RESISTING AND OTHER SPECIAL FIRE-CLAY MATERIALS FURNISHED IS OF THE HIGHEST ORDER; AND THE SYSTEM AS A WHOLE, AS NOW PERFECTED, IS THE RESULT OF LONG EXPERIENCE AND CAREFUL STUDY OF THE PRINCIPLES OF GASEOUS FIRING.

Drawings and Tenders are furnished for the complete erection of Benches, including Retort and Bench Mounting of the most modern and approved description; or existing Ovens fitted up with the Patentee's arrangements.

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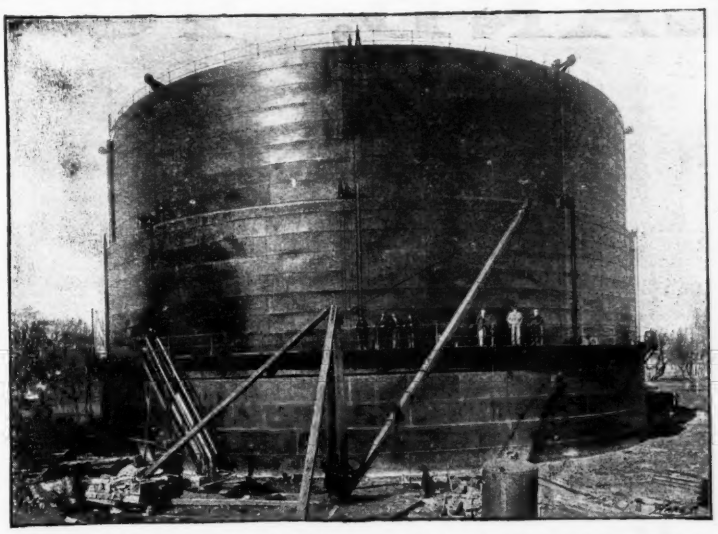

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AND WE FURTHER CALL ATTENTION TO THE EXTRACTS FROM THE JUDGMENT GIVEN BY THE HON. MR. JUSTICE WILLS, WHEN HE DISMISSED THE WELSBACH COMPANY'S APPLICATION FOR INJUNCTION:—

"No use is made by the Sunlight Company of any of the rare earths; and their choice of substances, and their method of applying the illuminants, appear to me to be **as wide asunder as the Poles** from those contemplated by Welsbach."

"Welsbach Company's Counsel, both admit that they have no case unless the Welsbach skeleton, of whatever resistant earth oxides composed, is within the Welsbach Patent. It seems to me that **this is just what Welsbach did not claim.**"

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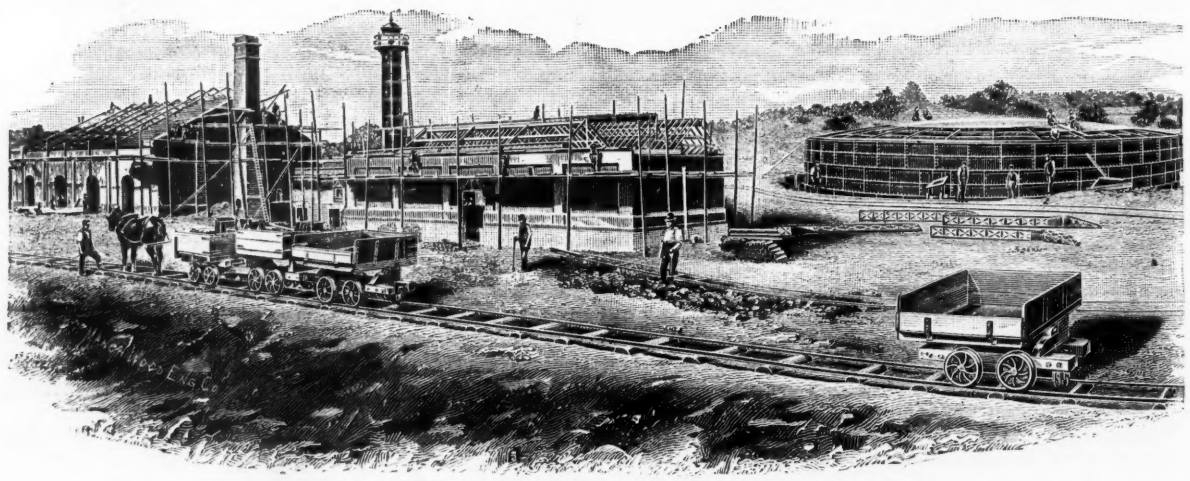

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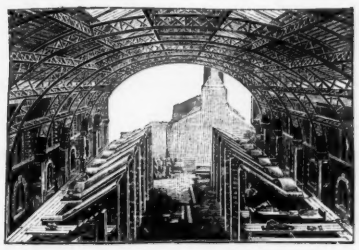

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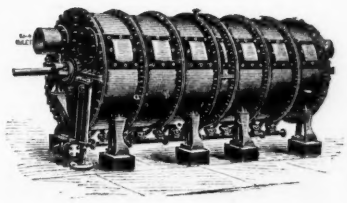

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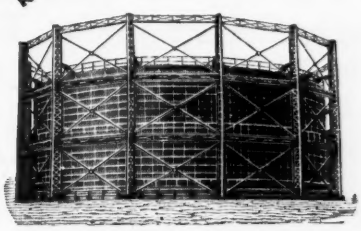

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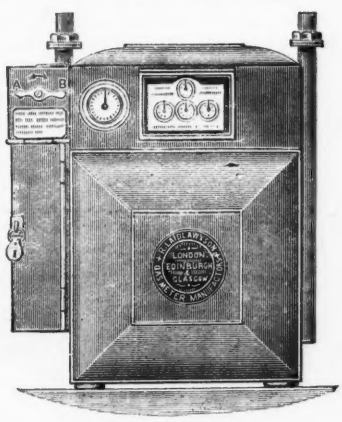

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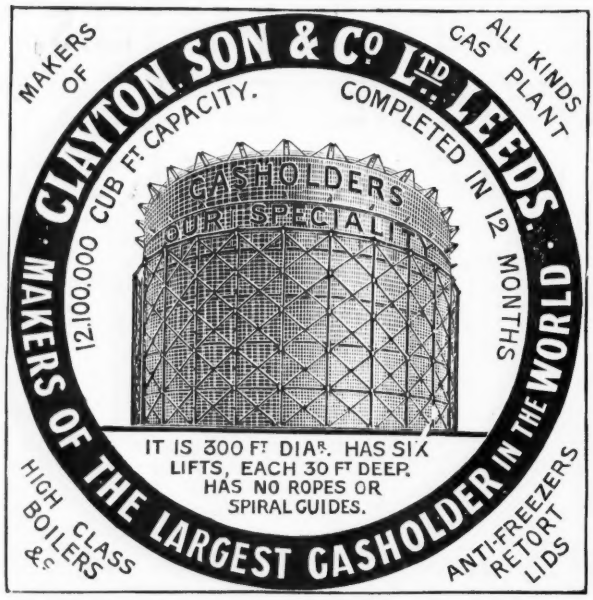
[See Illustrated Advertisement, June 22, p. VII.]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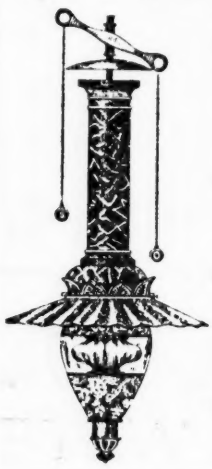

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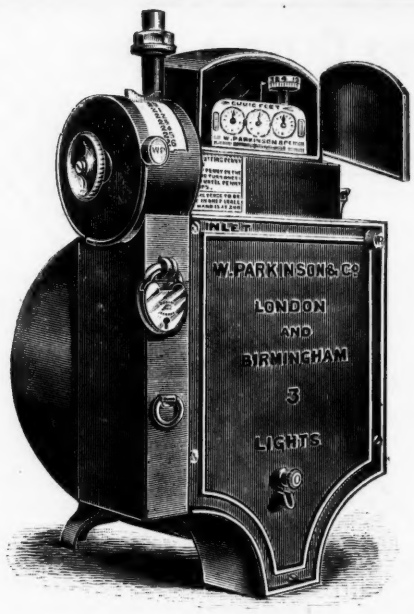

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[See also Advt. p. 1472.

LONDON: Printed by WALTER KING (at the Office of King, Sell, and Railton, Ltd., 12, Gough Square); and published by him at 11, Bolt Court, Fleet Street, in the City of London,—Tuesday, June 29, 1897.